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Chemical Weekly

VOL. XXXVI NOVEMBER 20, 1990 NO. 11

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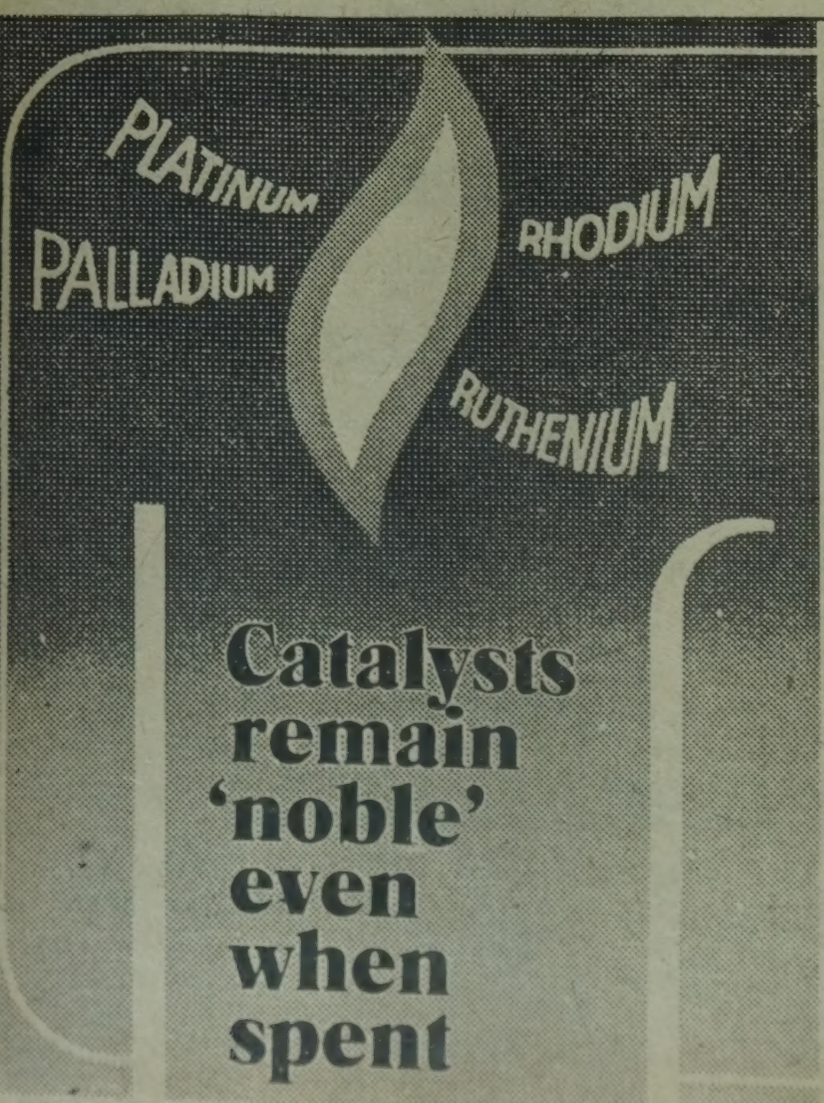

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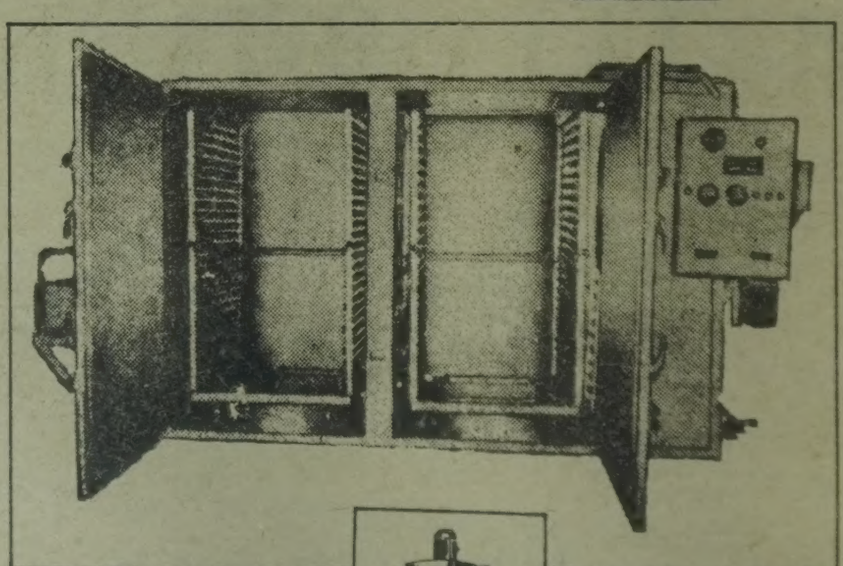

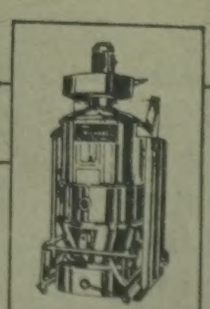

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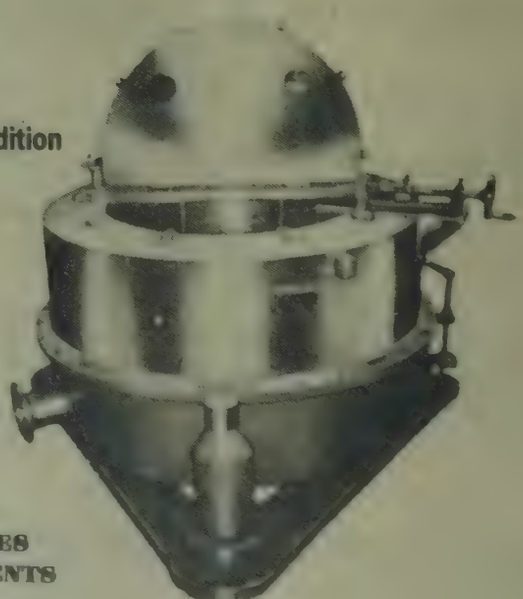

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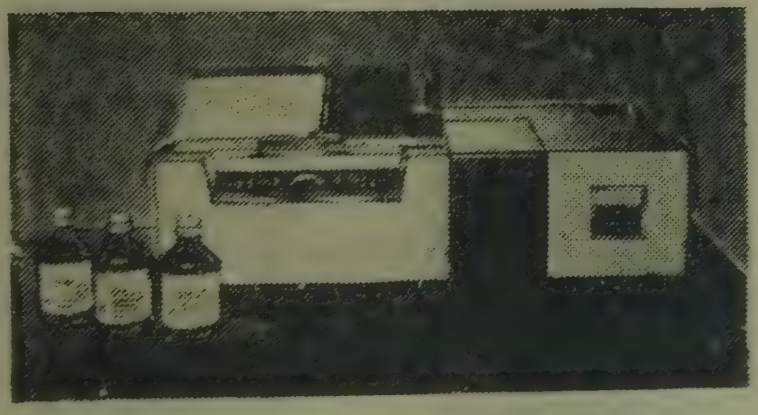

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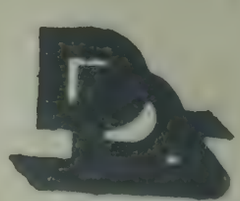

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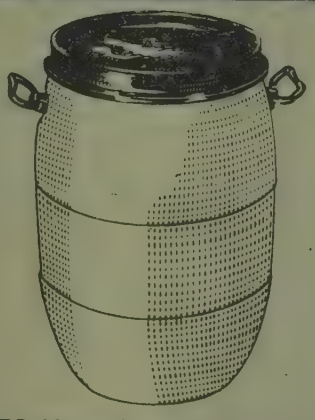
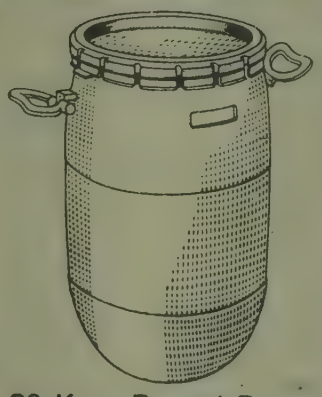
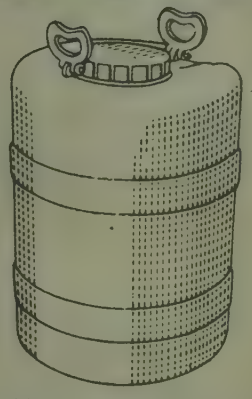
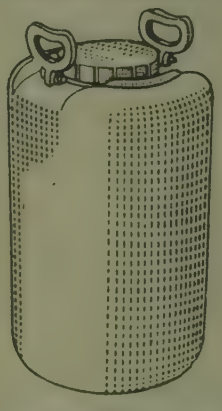
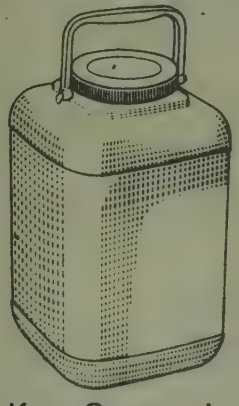

50 Kgs. Round Drum
Full Top Open – 12" Cap

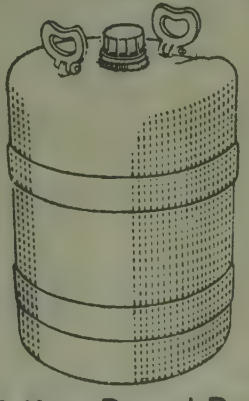

30 Kgs. Round Drum
Full Top Open – 10" Cap

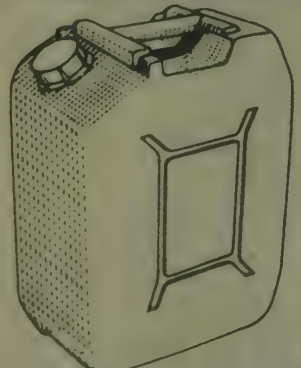

50 Kgs. Round Drum
– 6" Cap

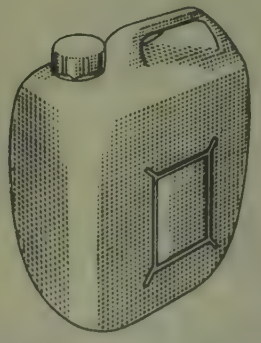

30 Kgs. Round Jar
– 6" Cap

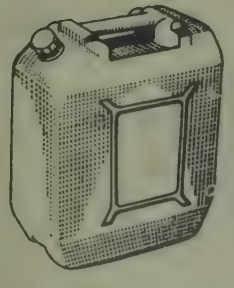
20 Kgs. Round Jar
– 6" Cap

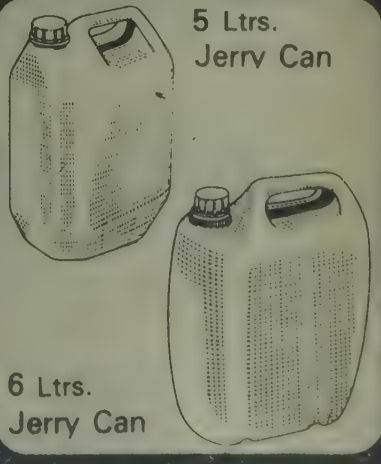

6 Kgs. Square Jar
– 4" Cap


50 Kgs. Round Drum
– 2" Cap


30 Ltrs. Jerry Can
Stackable


20 Ltrs. Jerry Can


10 Ltrs. Jerry Can
Stackable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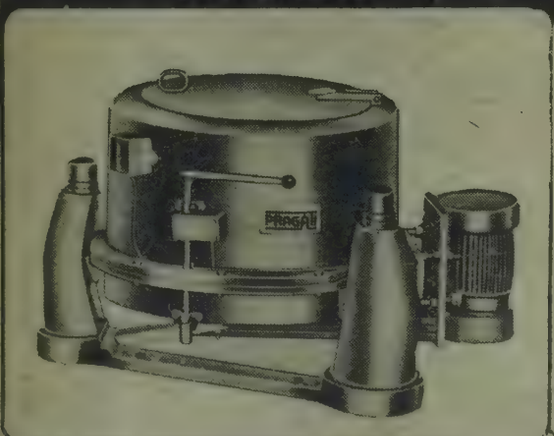

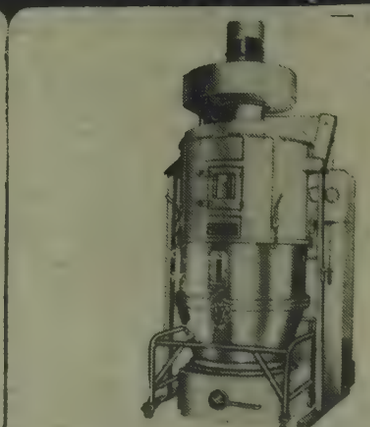

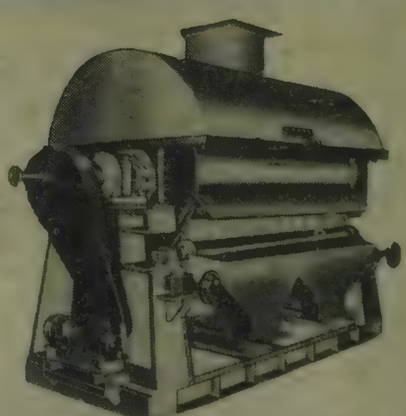

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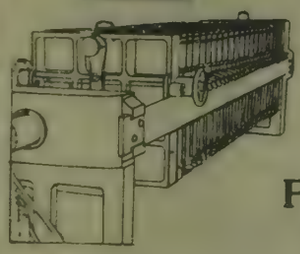

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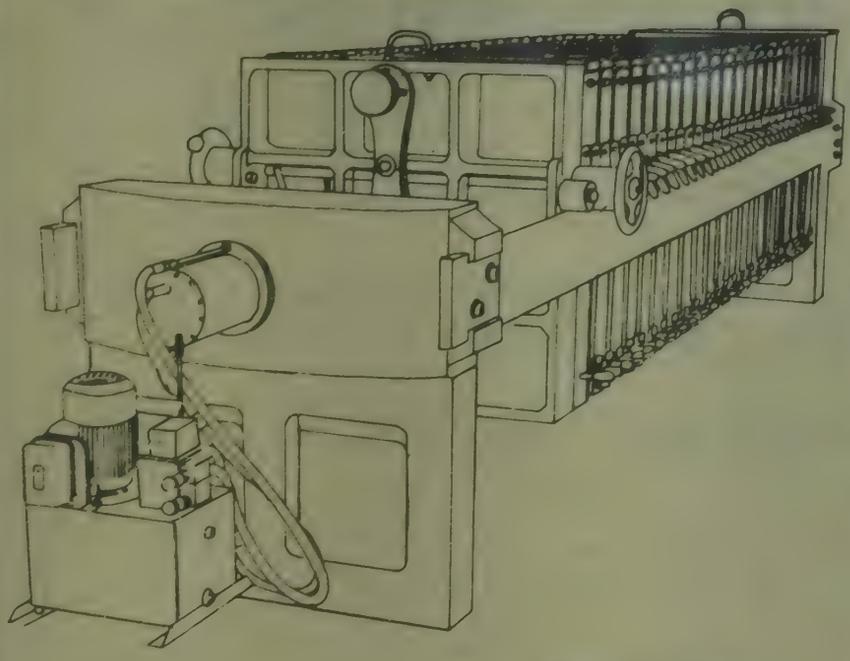

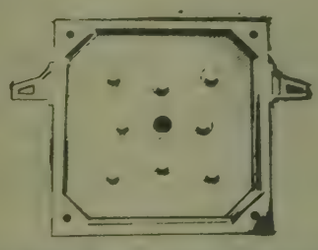

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CONTENTS

Computers mimic human learning — T.P.S. RAJAN 41
Chemarena — S.L. VENKITESWARAN 45

IN THE NEWS
Staggering of aromatics projects favoured: MRL may win over JK group 48
Oxalic acid exporters seek sugar at export price 50
RCF presents Rs. 11.03 crores dividend 50
Thapar-Du Pont project: approval despite reservations 50
New guidelines for petrochemical projects 51
Feasibility report on Assam gas cracker project 51
Clearance soon for petro projects 52
Probe into mishap at IPCL plant 52
IPCL mishap results in Rs. 30 crores loss 54
Delay in restarting IPCL unit: Rs. 180 crore petrochem imports necessary 55
PIB clears BPCL's n-paraffin project 56
Chemical exporters plead for hike in CCS 57
Phosphoric acid import likely 64d
Indian scientist contests findings of Nobel laureates 81

PHARMACEUTICAL CAPSULE
CCS for two more drug intermediates 50
Maharashtra bans substandard drugs 56
Gujarat Glass, Nicholas Laboratories to merge 58

PESTICIDES AND FERTILISER BRIEFINGS
Pesticide export may touch all-time high 60
Pesticides to be brought under PMP 60
Fertiliser imports through Calcutta, Haldia ports fall 64a
Efficient use of potash stressed 64a
GAIL moots gas-based fertiliser units abroad 64c

ENVIRONMENT NEWS
$160 m ozone layer fund for Third World 66
British Prime Minister urges swift action on global warming 67
Experts call for studies on global warming 67
Rich lifestyles threaten earth's climate 68

OIL & NATURAL GAS SCENARIO
ONGC bid to step up gas utilisation 70
Oil intake in South declines 70
11% rise in world's gas reserves 72
Clearance for ONGC oilfield project 74
Gas development: IBRD to aid ONGC 75
Tripura seeks cut in gas prices 75
Digboi refinery to make speciality products 75
Global tenders only for cabinet approved projects 77
Ethanol, a petrol substitute 78
ONGC approves 131 tech. tie-ups 79
ONGC to commercialise technology 79

MINERALS AND METALLURGICAL FRONT
Aluminium ingots prices raised 68
Status of Mineral Exploration Corpn. upgraded 81
More pig iron for AP units 83
Ore order to Romania hit 83

REGULAR FEATURES
Highlights in Chemical Technology 89
Food and Pharmaceutical Technology in Perspective 93
Production Management — Part-I — Introduction — N.R. PAI 97
Science Briefs 101

SPECIAL ARTICLE
Chemistry of Acrylic & Allied Polymers — Prof. V.A. SHENAI 105

INTERNATIONAL SPECTRUM
International Market Update 123
News about New Projects 127
News from Japan 129
New Developments from Japan 131

MARKET INFORMATION
Bombay, Delhi, Calcutta, Madras 141-150
Shipping News 151
Materials Imported/Exported 153

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CHEMICAL WEEKLY

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Computers mimic human learning

Artificial neural networks today are the computing tools that simulate the learning process and could revolutionise the chemical process industries.

Developers of neural nets are betting on their rapid use in data analysis, pattern recognition and decision making. And major CPI firms are looking into possible applications in product formulation, quality inspection, process modelling and control.

Named after the network of neurons in the human brain — and some say it's really a misnomer — neural nets have been under development since the '70s. Much of the work has been in generating software that simulates the learning behaviour of a hypothetical brain. Hardware chips to build neural net products are now becoming available.

Neural nets differ from expert systems in that they learn directly from examples, using special learning algorithms instead of the programmed rules-of-thumb based on knowledge that an experienced scientist or engineer would apply to solve a problem. A number of neural net learning algorithms have been developed and patented over the years, and some are particularly suited for "supervised" learning, while others excel at "unsupervised" learning.

A user "trains" a neural net by "showing" it examples of the input it will receive, paired with the output it is to deliver. The neural net "learns" the correlation between the input examples and the expected outcome, and is able not only to repeat these examples, but to generalize relationships for inputs and outputs that were not used in the training phase. Because of this, a trained net is said to be capable of intelligent interpolation.

Made up of a number of interconnected software or hardware building blocks called processing elements, neural nets vaguely resemble the architecture of the vastly more complicated network of neurons in the human brain. The degree to which one processing element relates to another is a function of its connection strength or weight. The weights of pertinent connections are stored in a matrix. An array of inputs fed to the network is called an input vector, and the corresponding outputs constitute an output vector.

The processing elements are usually grouped together into linear arrays called layers. Most neural nets consist of three to five layers, namely the input layer, the middle or hidden layer(s) and the output layer.

It is neural net of the feedback type that has the remarkable ability to learn from its own experience without being explicitly programmed for each new input. It can not only detect patterns or significant relationships in data, but also remember the patterns by associating them with the weights assigned during the training phase.

Among a variety of available learning algorithms, perhaps the most popular is the one called the back-propagation-of-errors algorithm. One version of this — the generalized delta rule — enables errors to be propagated backwards from the output layer to the middle layer(s) and on to the input layer.

Thus, a neural net programms itself from the information fed to it. The output, which is based on actual relationships discovered from the data supplied to the system, is obtained without the intervention of external programming.

Experts in the field believe that when the powerful neural net chips find their ways into products, they will eliminate some of the tedious programming and reprogramming that conventional computers require now.

Overselling the Promise?

Critics argue that neural nets have yet to prove their worth: That they sometimes give incorrect answers, are not developed enough to have generic applications, and are so difficult to understand that they can't be improved even if a user thoroughly understands the process to which they are applied.

Some experts are battling those who make extravagant claims. "To say that neural nets are slick brains is hogwash," says Robert Hecht-Nielsen, chair of the board of HNC Inc. (San Diego, Calif.), a company offering a variety of neural net products. Neural nets are really no more exotic than proportional-integral-derivative (PID) controllers. And their range of applicability is fairly narrow.

Potential Applications

"Neural nets are indeed suitable for modeling very slow processes with long time constants," says Wayne Jones, manager of advanced technology at Fisher Controls International Inc. (Marshalltown, Iowa). "They can identify correlations very well, but one has to be able to match the technology with a product."

Still, merits far outweigh deficiencies, especially when one compares neural nets with expert systems. In the real world, it would take an ominiscient programmer to anticipate every possible combination of circumstances with which an expert system might have to deal, says Thomas McAvoy, Chairman of the chemical engineering department at the University of Maryland (College Park). A neural net, on the other hand, can adapt to unforeseen situations because it is not so much programmed as it is trained.

Moreover, adds McAvoy, human expertise is not only in the form of rules but also in the guise of skills. Skills are too basic forms of knowledge to be described by rules. McAvoy's research group is working on methods of training a neural net to learn basic skills such as the control actions of a human operator. The group has discovered that it is much easier to train a neural net than it is to design and build an expert system.

Research also indicates that if an expert system is designed to control a plant and the plant is later modified, it may well require that the whole expert system be rebuilt. Whereas with a neural net-based system, with the change in the plant, all one would have to do is retrain the system.

For the time being, vendors say that applications benefiting most from neural nets are those that require the understanding and recognition of patterns. Applications in environments where multiple variables are continually changing, such as industrial process control or business trend analysis and decision making are also suitable.

For example, short-term prediction of trends in chemical prices is now possible with neural nets. Buzz Woods, senior associate and artificial intelligence specialist with Olin Chemicals (Cheshire, Conn.), has successfully used neural nets to predict trends in the prices of 33 petrochemicals.

By training the net with historical prices of a select set of petrochemicals and economic indicators, Woods has been able to create a network that effectively captures relevant relationships in the data. When applied to forecast one to two months in advance, most of the predictions differed by only 6% from the actual numbers. And all network outputs were correct in predicting the direction of the price fluctuations.

Trained for Flexibility

The ability of neural nets to predict trends extends their use in process plants, too. During abnormal operation of the plant, neural net-based control systems can respond appropriately, because they can determine relationships connecting given sets of parameters, not just values of parameters that characterize the abnormal dynamics.

By training a neural net with examples of various combinations of inputs and corresponding outputs, the system teaches itself the multi-dimensional mapping of the problem, notes Hecht-Nielsen. Rather than coding many rules or algorithms, neural nets conceptually draw and remember the outline of the multi-dimensional cloud. In the event of an abnormal condition, they can discern the abnoramality even though their training might not have included that particular abnormal case. Neural nets, however, have to have input data that are repeatable. They do not tolerate large systematic, errors, although "noise" or random errors are less of a problem.

Indeed, the noisier the process, the more suitable neural nets are for its control. Neural nets have intrinsic "robustness" that makes their use in process control even more attractive, says David Himmelblau, Professor of Chemical Engineering at the University of Texas at Austin.

Experts point out that even when the data set is incomplete and contains gaps, errors and duplications, there are ways to accomplish data-quality assessment, data sorting for errors and duplications, and "filling-in the gaps" through an approach called unsupervised learning. In essence, one asks the neural net to find natural clusters in the input data. From this, one might discover that there are several clusters of data, perhaps reflecting several different relationships.

One might also find that some data lie outside the prevalent clusters. These deviating points are analyzed to determine whether they represent bad data, or a different but equally acceptable relationship. Identification of clusters are used to eliminate gaps and duplications. If data points are tightly clustered, one simply uses the centroid of that cluster as a single data point. This approach is often used to manage large data sets.

Model-based process control (MBPC), used successfully in many chemical process-control systems, collects data from the plant to create a model of the process, explains Hecht-Nielsen. The model is then used in the control system to predict the response of the process to a particular set of control signals. Most MBPC approaches have used linear techniques such as frequency-response analyses. For many chemical processes that have non-linear dynamics, an MBPC approach, using a modeling technique that captures these non-linearities, should perform better than a linear one.

A beginner can analyze plant data and quickly come up with neural net models for non-linear processes, says Robert Cox, Planning Manager at Du Pont Co. (Wilmington, Del.). Unlike the effort needed in developing dynamic models of processes that require knowledge of advanced mathematics, all, the user has to do is ensure the quality of the input data and that the examples fully represent the range of the problem.

Capture non-linear effects

The University of Maryland's Thomas McAvoy and research assistant Naveen Bhat have built a neural net model to predict the non-linear response of pH in a stirred tank reactor. They trained a neural net to predict future values of the pH level given the flow-rates in one of the input streams, as well as the past pH values.

They discovered that neural net models are as accurate as linear models as long as pH values were kept at the same level as those used in training. However, when they changed the target pH level, the neural net was more effective than conventional linear models because the neural net had captured a more accurate picture of the non-linear relationship between the flow rates and the pH level.

Meanwhile, engineers at Shell Development Co. (Houston, Tex.) are developing an adaptive control system using neural nets. The system will perform qualitative interpretation of process sensor data sampled at discrete intervals of time, according to one of the developers of the software. Texas man Co. (Longview, Tex.) is pioneering another application of the technology to optimize chemical production.

Neural networks can also recognize structural formulas of molecules. Using Neocognitron, a pattern-recognition device developed by NHK's Science and Technical Research Laboratory (Tokyo, Japan), neural net software is being trained at Netrologic Inc. (San Diego, Calif.) to recognize chemical strutures. This project, sponsored by the U.S.'s National Institutes of Health, is expected to deliver a neural net package that would be able to scan a given formula, match it with those in an online database, and thus eliminate the time-consuming visual search by a human operator.

Opening the 'Black Box'

A major disadvantage to neural nets is their complexity. To many users they are merely black boxes. Improving their performance, therefore, is virtually impossible, says Du Pont's Cox, regardless of how well the user understands the process.

Help, however, should be available from new neural net support products. For example, the Knowledge Net software package from HNC can not only explain how an answer was derived but also generate a set of if-then rules automatically from the training examples. This product also complements efforts of "knowledge engineers," whose job it is to extract the if-then rules for building expert systems from interviews with experts in a particular knowledge domain.

Neural nets also sometimes give incorrect answers. To explain this phenomenon, some industry experts theorize that neural nets fail when they are asked to predict an "unobservable variable." This situation may arise when there is a mismatch between the number of processing elements in a neural net and the number of identifiable patterns in the data set. Another possible reason for failure is an insufficient number of trials (iterations) in the training phase.

According to the University of Maryland's McAvoy, the "fuzzier" the industry, the more powerful neural nets are over other methods in tackling problems. The food and beverage industry is an example where the processes used are often not well understood. With the hope of effective use of neural nets in modeling and control of such processes, similar industries are banding together to compare notes.

There are a number of vendors offering a wide variety of neural net products, ranging from relatively inexpensive software tools for developing one's own applications to turn-key systems for online inspection, process control and custom materials formulation. Accordingly, prices vary from a few hundred to hundreds of thousands of U.S. dollars. Different versions of the software tools may run on several platforms including the Macintosh, the IBM PC and compatibles, and the VAX or Sun work-stations.

Delta AI 1016 is a new hardware product designed to provide direct high-speed interface to exchange data between external sensors and neural net software. The unit performs complex learning algorithms on data collected from sensitive real-world applications. Industry experts believe that this device will aid in eliminating one of the biggest problems with training a neural net from real-time data.

Using a "bomb-sniffing" neural net in an airport-security device called Thermal Neutron Analysis system, this turn-key system is trained to detect various chemicals contained

within carry-on pieces of luggage, and tell the difference between concentrations of chemicals in miscellaneous items, such as the nitrogen in an explosive from the nitrogen in a package of frozen chicken, according to the developer of the system — Science Applications International Corp., San Diego, Calif.

A monitoring device uses neural nets to recommend the tool-change time for industrial machining equipment. Simple microsensors feed data to a neural net that has been trained to detect the dullness of drills before the machined parts exceed their tolerance limits — Netrologic Inc., San Diego, Calif.

Nestor Learning System uses a patented paradigm called Restricted Coulomb Energy Paradigm to "compile" a number of independent neural net modules to solve a particular problem. This design philosophy is said to yield faster execution and flexible updating. Ideal for identifying peaks in "noisy" sample traces using spectroscopic and chromatographic analyses, the system can also be used in developing neural net products for process control, says the company — Nestor Inc., Providence, R.I.

Neural Works Explorer is a training and development software for those who want to learn the techniques of neural computing and how to use them in small applications. Neural-Works Professional II, on the other hand, is a full-fledged development tool that comes complete with Insta-Net to generate standard network types from an extensive library. With versions that run on the Macintosh, Sun work stations, the IBM PC and compatibles, the system can be used to create custom networks, says the company — Neural-Ware Inc., Pittsburgh, Pa.

NetSet is an easy-to-use network interface that simplifies neural net product development with menus, pop-up windows, and fill-in-the-blank style forms that allow a user to input data files, configure the network, design the file output, train and operate the network. Anza Plus, a neurocomputing co processor, designed to perform high-speed operations, communicates with NetSet using the User Interface Subroutine Library.

For advanced neurocomputing functions, there is Neural Network Development Toolkit that includes Axon, a second-generation description language for neural nets users to create new paradigms and customize existing ones from HNC Inc., San Diego, Calif.

—T.P.S. RAJAN

(Condensed from Neural Nets by Gulam Samdani in *Chemical Engineering*, April 1990)

CHEMARENA

S.L. VENKITESWARAN

Recycling plastics

Du Pont, Waste Management Inc. and American Can are planning a joint endeavour for enlarging recycling of plastics. So far only one or two of the plastics have been taken up for recycling. Now a large scale effort to recycle a variety of plastics is being taken up at Chicago by the three. PET, soft drink bottles, HDPE milk jugs, and laundry detergent bottles account for 65% of volume of all plastics in the waste stream in USA. The joint venture will supplement Plastics Recycling Alliance (of Du Pont and Waste Management).

The target is 40 million lbs. of HDPE and PET in 1992. Other plastics like PE, PP, PS and even multilayered bottles are to be handled. An improved sorting system is to be used. Multilayered bottles will be recycled without separation and the material is good for pocket combs, pallets, office trays etc. Sensing equipment is also to be developed by Du Pont for sorting.

ANC -- American National Can -- is based in Chicago with $4.3 billion sales of plastic and glass packaging and aluminium and steel cans with extensive kerb collection facilities which will be further expanded. This era of recycling will surely get a boost from the higher prices of petrofeedstocks and virgin materials.

Air Pollution Realities

"Dirty Air' around is a subject of much argument and controversies in the West and Japan though we in India have to be far more conscious of our environment. Leaving this main problem, the recent arguments in USA is on the use of cloth and of disposable diapers. There is a lot of washing of dirty linen in public as per editorial comments in *Science* of 28 Sept. There is apparently no clear advantage of either.

Presently 18 billion disposable diapers are discarded annually in U.S.A., which are perhaps 2% of all municipal solid waste. Cloth diapers are less than 1% but use up a lot of water and detergents; for disposables there is the added use of delivery systems using petroleum drum and from the burning. One estimate is that the use of disposables causes less pollution overall and less use of energy apart from being a matter of great convenience. One argument is that cloth diapers have to be pinned tight and often cause hurt to the fingers as against paper disposables with a snap on grip. Much of the arguments on either side are quite involved and of little importance. There are the questions of water use, energy consumption, exhaust emissions, waste disposal, pesticide use on cotton and so on. Cost benefit analysis may be only partly correct. The questions relate to the way of life with the alternative conveniences. May be disposable diapers may be too minor a problem blown to controversial heights when far more relevant problems of global environment are assuming alarming proportions. In any case India is not likely to face a problem of disposable diapers.

India's exports of bulk drugs

One of the creditable achievements in recent years by the Indian pharmaceutical industry is the success in export of bulk drugs. Two major items are ibuprofen and sulphamethoxazole which touched Rs. 116.8 million and Rs. 34.12 million in 1989-90. There has been a small decline in sulphamethoxazole due to lack of understanding between Indian producers who often undercut each other. Such problems resolve theselves in course of time but a far more serious problem could arise with ibuporfen exports to USA. This is the complaint raised by the sole US producer of this item in USA viz. Ethyl Corporation. It took a long time for this drug to get FDA approvals for sale as OTC -- Over the Counter -- drug and since then demand has soared.

The arguments are that India provides "massive" export subsidies which gives Indian producer a 20% cost advantage. At the same time high tariff barriers rule out imports into India. It is too early to say if a contervailing duty campaign will be launched. Perhaps not untill the GATT negotiations conclude. After all India is only assisting to the extent of differentials in the price of intermediates in India vis-a-vis in the world. India has captured market shares in Europe. Producers in India fully comply with the FDA regulation on the plans of manufacturing plants and obtain approvals.

With a reported capacity of over 3,000 tonnes a year, its own alkylation and subsequent process, it may look odd to have complaints from a sole producer in USA against import from India to the extent of 10% or less of US demands. But there is another development: Boots Drug and Hoechst-

Celanese are planning the production in USA with a capacity of the order of 3,500 tonnes. It is reported that US has been importing from UK -- as much as 2,000 tonnes which may be eliminated. US prices are $ 18 to 20 per kg. and so long as Indian production is on an improved lower cost route for the propionic acid side chain and develops its own production of isobutyl benzene there may not be any serious hitch in exports to USA or Europe of ibuprofen.

High Level Nuclear Waste

Since the advent of nuclear power, the disposal of high level nuclear waste (HLW) from spent fuel rods of the reactors has been a serious problem. Where plutonium is to be recovered the wastes are used but otherwise the spent rods are stacked in large basins of cold circulating water. The liquid wastes from plutonium recoveries are stored in steel vessels below the ground. These HLW generate high energy radiation for centuries but these can be absorbed by the circulating water which should not escape. HLW requires total surveillance under these conditions for thousands of years. The way out proposed is disposal underground, deep enough to avoid any effect on the surface world for centuries. The underground cavern has to be in a geostable region and in suitable containers and without possibilities of contact with water which may ultimately move up.

An exercise to choose such a repository for HLW from US power plants has been going on for years and although a site is agreed upon it has not been possible to take preliminary steps even after a legislation -- Nuclear Waste Policy Act of 1982 -- with plans to have a mined repository by 1998. The Yucea Mountain in Nevada State is said to be approved but the State is adamant in opposing this and has vetoed the project. There is the NIMBY syndrome -- not in my backyard -- which comes in when any element of risk is involved even after centuries.

Most European countries seem to adopt a deliberate policy of postponing a final decision on an ultimate repository. Meanwhile the watery grave in readily accessible surface level continues to build up. Arguments always arise on effectiveness of any selected site and its zero risk status. No solution seems to be likely for two decades and there are talks of indefinite postponement of the ultimate disposal whether in USA or Europe and accept the present arrangements as a necessary evil. But the present arrangements are becoming increasingly difficult, more so for their continuation after present nuclear power plants are to shut down in concrete silos after they reach their safety life-span (in 30 years operation). India also has to get this problem solved in the coming decade if we are to get on with our ambitious nuclear power programmes.

Polystyrene faces problems

Styrene and benzene prices have risen and supplies reduced with the consequent impact on price of polystyrene. There is also the concern on its use for some areas of packaging such as foamed cups and sheets which are used and thrown away. The largest user of these -- McDonald -- has decided to drop it in response to the criticism. US production is expected to fall slightly this year to 2.3 million tons after three years of growth totalling 25%.

Higher prices also led to inventory rundown. Supplies have been disrupted by the explosion and fire at Arco's plant, and by problems at other plants. As US has been a large exporter, the impact is most on exports. The break-up in the use of polystyrene in US and styrene world-wide is reported as under: (*CE News, 15.10.90*).

Polystyrene in US - 1989 (Total of 5.13 billion lbs)

Packaging	26%
Consumer & Insulation	23%
Electrical & Electronics	15%
Building & Construction	10%
Exports	4%
Furnitures and furnishing	4%
Others	17%

Estimate of Global Styrene use 1990 (of total 13.5 m. tons)

Polystyrene	66%
ABS/SAN	12%
SBR	7%
SBL	6%
Unsaturated esters	5%
Others	4%

But additional global capacity is coming up estimated at 6.5 million tonnes over the present 14 million tonnes. Paper for packaging seems to be gaining because of the recyclability though it is not correct to expect this for all forms of packaging paper. Polystyrene recycling is being actively promoted and it is probably the easiest to reprocess. It is possible that there may be some impact on production of virgin material in the coming years. Exports from US will face decline due to rise in capacity elsewhere. But prices everywhere are shooting up, particularly in India where it is the highest priced of the commodity plastics with no early addition to capacity in sight. Of course Indian consumption of polystyrene is the lowest of the four major thermoplastics and only ABS has surged in recent years. Production of SBR is also stagnant. Some serious rethinking on our plans for styrene is called for.

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STAGGERING OF AROMATICS PROJECTS FAVOURED

MRL may win over JK group

There is a dominant feeling in New Delhi in favour of staggering the implementation of the two aromatics projects, one at Madras and the other at Saleempur, with a gap of two to three years. This is a new development and if implemented, it will mean one of the two projects, probably the one of the JK group, getting delayed with consequential cost-overruns.

Madras Refineries Limited (MRL) and SPIC, Madras had joined hands to set up an aromatics complex at Madras for which a separate company called National Aromatics and Petrochemicals Corporation Limited (NAPCO) was formed in May 1989. The competitor for the project is the JK group which wanted to put up a similar project in Saleempur in UP.

The idea of staggering the implementation of the project has arisen in view of the feeling in New Delhi that there was no scope for taking both the projects at the same time. The chances of MRL getting precedence over the Saleempur project are bright and its claim is strong considering the fact that all the needed clearances have been given and the partners have already done a lot of groundwork spending crores of rupees.

In fact one of the last acts of V.P. Singh's government was to clear this long-dreamt mega project for Tamil Nadu, whose successive governments had been pressing for this prestigeous complex which involved an investment of Rs. 1,380 crores including a foreign exchange component of Rs. 306 crores, with a debt equity ratio of three to one.

When Mr. Singh last visited Madras and addressed the press as Prime Minister in September, he announced to the delight of Mr. Karunanidhi that his Cabinet had cleared the project. To a query he stated that there was no need for other formalities like going through the PIB, etc. since the Cabinet was superior. Subsequent events suggest the PIB did indeed get the whole proposal and okayed it at its 355th meeting held on November 1, at New Delhi after which the proposal, perhaps in its final shape, came before the Union Cabinet on November 2 for final clearance according to informed sources.

It was at this PIB meeting, it is understood the matter was discussed at length and various options came before the government, one being whether both the MRL's and JK's projects should be implemented simultaneously or staggered. Sources said that the overwhelming view of the meeting was that since MRL already initiated several measures spending crores of rupees and was in full preparedness to implement this much-delayed project it should get the precedence.

But the green signal given by the PIB was subject to two riders, all of which Mr. V.P. Singh did not indicate earlier. One was that MRL shall not resort to loans from financial institutions and that foreign exchange requirements of the project should be met only through export earnings. To both these propositions, it is understood, MRL had agreed in view of the encouraging prospects of the project with availability of enough surplus at its disposal.

In addition to these two conditions, there were also six other stipulations. One of them related to the question of tying up with Mitsui. Mitsui, a Japanese company, it may be recalled was blacklisted by the previous government for its alleged payments to Indians in an ONGC deal sometime back. MRL's aromatic project is to have both financial and technical collaboration with Mitsui. The PIB's other condition is that MRL's tie-up with this Japanese company which was only a part of a big consortia "could be given a final shape only if it is decided to reverse the government decision on blacklisting of this company". Observers do not anticipate any hitch on this score.

The PIB's other conclusion is more interesting and encouraging for the MRL and its chairman, Mr. H. Krishnamoorthy. It was felt by the PIB that a strong professional management was a pre-requisite for successful implementation of the project and therefore it was necessary for reviewing the earlier MoU between SPIC and MRL with regard to management responsibilities.

The thinking in New Delhi is that MRL should have a greater say in the matter of management since "it has a very good management track record in the field". The implication of this particular conclusion of PIB is deeper and it might mean enhanced equity participation by the MRL and or some other ways to implement that 'greater-say' status.

Under the MoU while MRL had the right to appoint the chairman and SPIC the vice-chairman, the new company NAPCO would have to recruit other professionals and the managing director. MRL is gearing up to implement this project in Madras and anxiously awaits the crucial formal project approval letter from the Ministry of Petroleum and Chemicals as was done in the case of 'mini-refinery' (distillation plant) at Nagapattinam, also being put up by the MRL.

The project has been cleared from the environment angle. Way back in 1985 following the doubling of MRL's capacity from 2.8 mt to 5.6 mt the idea of making best use of the high aromatics naphtha out of Bombay crude processing was conceived. Before the expansion of the low aromatics naphtha that was coming out of the imported Iraq crude was diverted to the nearby Madras Fertilisers as feedstock. Bombay crude was yielding as much as

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seven lakh tonnes of high aromatics naphtha.

The first public demand for the aromatics project in Tamil Nadu was made in 1985 during Mr. Rajiv Gandhi's visit to Manali but he did not give a straight answer. Meanwhile on February 6, 1987 MRL obtained the LI to manufacture 150,000 tpa of PTA, 30,000 tpa of orthoxylene and 13,000 tpa of benzene.

But uncertainty about the project, despite positive statement from the government officials, had persisted since JK's proposal at Saleempur received blessings from the then government.

In August 1989 the government revised the minimum economic size (MES) for PTA and accordingly the MRL's was also revised to two lakh tonnes. This has resulted in the escalation of project cost from Rs. 1,230 crores to Rs. 1,356 crores (August 1989 prices).

There is the likelihood of further escalation in the MRL project cost. It is also stated that MRL will have no problem in servicing the foreign exchange component (over Rs. 300 crores) since there is a good possibility of exports at least to the tune of 50,000 tpa to 60,000 tpa of PTA, which will be equivalent to 25 to 30 per cent of the production.

The swift implementation or otherwise of the project will all now depend upon the new government.

CCS FOR TWO MORE DRUG INTERMEDIATES

The Union government has given Cash Compensatory Support (CCS) for two more drug intermediates. The two drug intermediates for which 18 per cent CCS will be applicable are: disodium pamoate and L-H-tetrazolylacetic acid. This will apply to exports of these items in pursuance of offers, orders, contracts received and finalised on or after October 26, 1990. The CCS is however, valid for six months — April 25, 1991.

OXALIC ACID EXPORTERS SEEK SUGAR AT EXPORT PRICE

A piquant situation has arisen from the government's recent decision to export five lakh tonnes of sugar at almost half the ruling domestic price. Major export-manufacturers of oxalic acid, who use sugar bought from the domestic market as raw material, have discovered that their foreign competitors, who use imported Indian sugar, have acquired an edge over them.

If only the government ensures supply of sugar at the export price to half-a-dozen Indian export-manufacturers, they will together be able to step up oxalic acid exports by an additional Rs. 10 crores within the next five months, it is learnt.

It may be recalled that the government recently decided to export about five lakh tonnes of sugar at $320 per tonne f.o.b. basis, as a measure to bolster the country's foreign exchange reserves.

Oxalic acid export-manufacturers have moved the government though the Basic Chemicals, Pharmaceuticals and Cosmetics Export Promotion Council (CHEMEXCIL) to supply them sugar at international prices as that would enable them to produce oxalic acid at a "very competitive price", according to Mr. B.B. Reshamwala, commercial adviser to Punjab Chemicals & Pharmaceuticals Ltd.

Mr. Reshamwala's company has already exported oxalic acid worth Rs. 2 crores in the past seven months. He expects to undertake exports worth an additional Rs. 2.5 crores in the next five months if sugar is made available to the company at international prices. "How can we continue to manufacture and export oxalic acid if we pay Rs. 9.50 per kg for sugar, while the Indian government sells it to our foreign competitors at Rs. 5.50 per kg?", he has asked. Exporters of oxalic acid have said that if sugar is exported in value-based form, it can earn foreign exchange many times more.

THAPAR-DU PONT PROJECT: APPROVAL DESPITE RESERVATIONS

Mr. Ajit Singh approved the controversial Thapar-Du Pont project to produce nylon-66 despite strong reservations expressed by the economic advisor to the Industry Ministry regarding the viability of the project, in his report to the special Project Approval Board (PAB).

The project was cleared just a week before the collapse of the National Front Govt. at the Centre. It was ostensibly cleared as a major flagship company was involved and there could be some long-term, spinoff benefits if Du Ponts are allowed to start the project, according to the minutes of the special PAB meeting on the project, held on August 3.

Incidentally, the project's file was pending with Mr. Singh for three months. But he started considering the long-term, spin-off benefits of the project only when he realised that the government might not survive for very long.

According to the minutes of the special PAB meeting, the economic advisor's report had made three important points, atleast two of which have been ignored while granting the approval. The report pointed out that the project should have a high export obligation.

While the government was insisting that atleast 70 per cent of the projection should be exported, the multinational company expressed its inability to export more than 42 per cent. And at the end, the Industry Ministry relented to the Du Pont demand.

New guidelines for petrochemical projects

The govt. will not provide any additional protection to new petrochemical projects by way of hiking import duties on products manufactured by them. In fact, the new projects should be prepared to face a lower level of protection. This is one of the five conditions, subject to whose fulfilment the govt. will approve new petrochemical projects. The conditions were finalised and approved by the cabinet at a recent meeting.

The other conditions are: preference will be given to 100 per cent export-oriented units, no free foreign exchange will be released for the petrochemical complex, financial institutions will not be allowed to provide any rupee loan to them and only plants of minimum economic size by international standards would be allowed to be set up.

According to the first condition, the cabinet has stipulated that new petrochemical projects should not depend on a higher level of import duties on their products to make them viable. On the contrary, the promoters and financing institutions should proceed on the assumption that the present level of protection may be lowered. This condition has been stipulated in the wake of recent instances where the government has been influenced to raise the import duty of certain petrochemical products to make operations of the domestic manufacturer of the same product viable. The government apparently does not want to offer such concessions for new projects.

The second condition is that the government would give preference to petrochemical projects, which are to be set up as 100 per cent export oriented units (EOUs). Also projects with firm buy-back arrangements to cover debt-servicing liabilities will be favoured by the government for clearance. This would mean that RPG Enterprises petrochemical complex with tie-up with Linde will be a clear favourite for the government, since it is being set up as an export-oriented unit.

The third condition is no free foreign exchange will be released for these complexes. Accordingly, it has been decided that all new letters of intent will contain a condition that servicing of any foreign exchange loan or equity will be through and only to the extent of export earnings of the project.

The only exception to this condition will be cases where international financial institutions would have an equity in the project or would have given a loan. In case of loans from such institutions, the government would have to be satisfied that export earnings are expected to be sufficiently large to service the loan. The fourth condition relates to rupee loans for petrochemical projects.

In accordance with the new policy, petrochemical complexes should not take any rupee loans from financial institutions. Any foreign exchange loans from these institutions, subject to availability of such resources with institutions, will have to be serviced from export earnings, according to these guidelines. The fifth and final condition stipulates that the government should approve only those plants which adhere to the international standards of minimum economic capacity norms. According to official sources, all the nine new petrochemical complexes, proposals for which are being considered at various stages, would be governed by these guidelines.

FEASIBILITY REPORT ON ASSAM GAS CRACKER PROJECT

The latest feasibility report on the Assam Gas Cracker project, recently approved by the Centre, had certified adequate availability of associated gas within the state to sustain a minimum economic size factor. The project was a technically and financially highly attractive proposition and expert observations indicate further scope for enhancing profitability by a versatile feedstock and product mix, a government press release said.

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Clearance soon for petro projects

The government's decision to consider clearance of the nine petrochemical projects, has swung the Ministry of Petroleum and Petrochemicals back into action. Very quickly, the Ministry has sent two projects to Public Investment Board (PIB) for final clearance. The first to reach PIB was the naphtha-based aromatic complex in Madras. The board considered the Rs. 1,500-crore project in detail and has understood to have cleared it but only with a condition that the promoters, MRL-SPIC Consortium, should indicate the export earnings that will finance the import cost.

The second project sent to PIB by the Ministry on November 4 is the IPCL's gas-based Gandhar olefin project. The project is yet to come up for consideration. After the PIB clearance is received, the projects will be sent to the Cabinet Committee on Economic Affairs (CCEA). Sources point out that CCEA meeting itself will now be delayed following political uncertainties.

The other five projects which have also got the first stage of clearance and are waiting to be sent to PIB for clearance are: GAIL's gas-based Auriya project in Uttar Pradesh; UB Petrochemical's naphtha-based plant in Vizag; RPG-Linde's naphtha-based 100 per cent EOU in Madras; NOCIL's expansion programme in Maharashtra (naphtha-based) and JK's gas cracker in Madras. The Tata's Haldia project has already got the cabinet clearance, while the Assam's gas cracker project is yet to receive a letter of intent.

The total cost of the nine projects is about Rs. 26,000 crores and none of these will be backed by the financial institutions support. The MRL-SPIC joint venture will cost about Rs. 1,500 crores and that of Gandhar, to be executed by IPCL, will cost about Rs. 2,500 crores.

While it is pointed out that only IPCL is well-placed to execute the project because of its rich liquidity and expertise, the future of other projects look bleak. The MRL-SPIC project which has been cleared had originally envisaged FIs' support to the tune of Rs. 430 crores. It had proposed a public issue of just Rs. 130 crores. However, following stringent conditions imposed by CCEA, the Madras-based promoters will have to now tap funds to the extent of Rs. 600 crores from public.

The second condition imposed by CCEA that the projects should undertake matching exports to finance import requirement, will also hit the public sector consortium adversely. This is because the prices of naphtha in the international market has gone up substantially from the time the economic viability of the project was worked out. Even though the project cost was also revised upwards by Rs. 450 crores to Rs. 1,500 crores recently, the consortium was not prepared for the increased exports it will have to undertake following rise in naphtha prices resulting in increase in imports. This will mean that MRL-SPIC will have to amend its DPR based on the increased exports it will have to undertake if not because of rise in prices.

IPCL, on the other hand, is insulated from this problem since it is executing a cracker with gas as its main feedstock. The gas is abundantly available from HBJ pipeline. In addition, IPCL is unlikely to go in for import of technology as it is already executing a similar project in Maharashtra. Sources point out that the Ministry will not sit over any of the petrochemical projects and would send to PIB one after another. The projects are already delayed and any further delay will mean cost escalations. However, things like uncertain political conditions, might hold up the clearances. Meanwhile, it is pointed out that Assam gas cracker now has no takers. The last private sector party, Vam Organic, which was showing interest in the project is also likely to back out. The Delhi-based Bhartias have already withdrawn from the race to set up the Rs. 2,500 crore project. The ULFA terror is stated to be the main reason for loss of interest in the private sector to take up the project.

PROBE INTO MISHAP AT IPCL PLANT

Government has decided to set up a seven-member high-power committee of technical experts to enquire into the accident at IPCL's Maharashtra gas cracker complex on November 5 claiming 20 lives. The chairman of the enquiry committee will be Dr. R.A. Mashelkar, Director, National Chemical Laboratory, Pune, according to official sources.

The committee will enquire into and ascertain the causes of the accident. It will also examine whether the safety systems and emergency procedure established for the complex were adequate and were being regularly followed. The committee, which will submit its report within three months, will also review the operating and safety systems of the gas cracker plant as a whole and suggest measures to prevent such incidents, the sources said.

RCF PRESENTS Rs. 11.03 CRORE DIVIDEND

Mr. R. Chandrasekaran, acting chairman and managing director of Rashtriya Chemicals & Fertilizers Ltd. (RCF) presented a cheque for Rs. 11.03 crores towards dividend for the year 1989-90 to the Union Minister of State for Rural Development, Mr. Upendra Nath Verma, in New Delhi on Nov. 7. The minister, while accepting the cheque, complimented RCF for its excellent track record. Meanwhile the company has submitted proposals for an additional ammonia plant, nitrophosphate unit, dimethyl acetamide plant to the government for its approval. These involve an expenditure of Rs. 1,000 crores.

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IPCL mishap results in Rs. 30 crores loss

IPCL will incur a loss of Rs. 30 crore as a result of the mishap which occurred on November 5, destroying its unit in the Maharashtra Gas Cracking Complex at Nagothane. This is only a preliminary estimate, said Mr. Hasmukh Shah, chairman-cum-managing director of IPCL on November 7. As far as the machinery was concerned, all the hardware was under an insurance cover and the replacement costs would be obtained from the insurance firm, he said.

The gas cracker plant, located at Nagothane, Roha, in Raigad district was put up by IPCL at a cost of Rs. 1,390 crore. With the estimated Rs. 30 crore loss, this would go up by an additional two per cent, said Mr. Shah. The Nagothane plant, at 100 per cent capacity utilisation was expected to produce approximately 275,000 tonnes of plastic raw materials annually. The plant was expected to go on stream by the end of this month. As a result of the accident, the country will lose roughly $ 300 million foreign exchange annually (at full capacity).

India imports nearly 50 per cent of its requirement of polymers. The plant would have reduced the shortage of plastic raw materials in the country. The production target of the plant also included 50,000 tonnes of MEG, raw material for the polyester industry and 25,000 tonnes of wire and cable components for the telecommunications and power industry every year.

The plant was one of the first 300,000 tonnes cracker plants to be set up and IPCL was in the process of expanding this capacity to 4 lakh tonnes. The proposal for this expansion plan had been approved by the Public Investment Board and was awaiting final approval by the CCEA. The World Bank had agreed to provide $ 20-30 million for the expansion.

According to Mr. M.S. Gill, secretary, petroleum and chemicals ministry it would take six months to get the plant back into working condition. All efforts were being made to reduce this period. According to Mr. Gill, an in-house inquiry into the accident had already begun. A high level, fully equipped inquiry team would be set up to probe into the mishap, he added. The assessment would take about a fortnight, he said.

Mr. Gill also informed that IPCL would be given all kinds of assistance, in terms of import clearance, foreign exchange requirement, if any, by the government to help bring the plant back in working condition. The accident was one of the worst in the high investment petrochemical industry and took a toll of 21 lives. Fifteen others have been injured in the mishap.

Investment in the petrochemicals industry in the Thane-Belapur belt is believed to be around Rs. 483 crore. Major units include Herdillia Chemicals, NOCIL, National Peroxide and BASF. Several expansion plans, including the NOCIL project are on anvil. New projects expected to be set up in the region would involve an additional investment of Rs. 1,980 crore.

Total investment in petrochemicals in Raigad district today stands at Rs. 3,918 crore. Major projects include the Patalganga project of Reliance Petrochemicals and the MGCC set up by IPCL. A further investment of Rs. 175 crore is expected in the area, in particular by BASF. IPCL's sales turnover for 1990 amounted to Rs. 1,183 crore, an increase of 14 per cent over the previous year. Net profit stood at Rs. 96 crore during 1990.

The MGCC project was financed out of IPCL's internal resources and external borrowings. No financial support was provided by the government although a $ 210 million loan was rerouted from the World Bank. With the commissioning of the MGCC and the new NOCIL cracker, the production of commodity polymers in the state was expected to increase to 8.5 lakh tonnes from 1.5 lakh tonnes per annum.

Polymer-based goods' prices may rise

The explosion at the Maharashtra gas cracker complex (MGCC) of the Indian Petrochemicals Corporation Ltd. (IPCL) at Nagothane, a month before its commissioning, will entail a severe setback to the economy, cutting across various sectors. Petrochemicals industry sources in Baroda say that among the likely possibilities in the wake of the mishap are a 25 to 38 per cent increase in the price of widely used polymer-based products as well as intensification of the current energy crunch.

They point out that the commissioning of MGCC assumed importance against the backdrop of the current demand supply gap of about 1.5 lakh metric tonnes per annum in polymers. MGCC would have bridged a substantial portion of this shortage within a year had the explosion not occured.

Now, the delay in commissioning would mean that supply of polymers would further harden, starving about seven thousand plastic processing units in the small and tiny sectors inevitably pushing units in the small and tiny sectors pushing up prices of a wide variety of polymer based products, including clothing and some household items, the sources said.

The polymers slated for production at MGCC, include low density polyethlene, linear low density polyethylene, high density polythylene and polypropylene. Had the explosion not occured MGCC would have produced about 40,000 metric tonnes of polymers by March 1991 the source said. Among those worst affected by the shortage of polymers would be the cement-packing and pharmaceutical industries.

DELAY IN RESTARTING IPCL UNIT

Rs. 180-crore petrochem imports necessary

The six-month delay in recommissioning Indian Petrochemicals Corporation Ltd.'s Nagothane plant will necessitate import of $ 95 million (Rs. 180 crores) worth of petrochemcials which could have been produced at the plant had the blast not occured. It has also upset the schedules of serveral new projects which were to be based on feedstock from the Nagothane cracker plant. Prominent among them are the high density polethylene capacity expansion project of Polyolefin Industries Ltd., based on IPCL's ethylene and a 10,000 tonnes grassroot, plant.

A host of small units have come up in Raigad district based on commitments of supplies of ethylene oxide from the gas cracker. Delay in starting up the cracker will hurt them most. Some of these units already find it difficult to pay interest on their loans, according to industry sources. The Nagothane plants were expected to generate Rs. 900 crore sales turnover for the full year at today's prices. Assuming a 60 per cent capacity utilisation, the following tonnages were expected for six months of production: LDPE 24,000 tonnes, LLDPE/HDPE 39,000 tonnes, polypropylene 18,000 tonnes, MEG 15,000 tonnes and ethylene oxide 1,500 tonnes (the last item cannot be imported and hence has not been included in the foreign exchange outgo calculations).

Six months of sales would have amounted to approximately Rs. 270 crore. Internal resources generation which would have accrued to the corporation during the period would have been around Rs. 40.5 crore. The Gandhar petrochemical project, costing Rs. 2,665 crore, is to be financed to the tune of almost of 40 per cent from internal generation totalling Rs. 1100 crores. A Rs. 40-crore drop in this amount will not as such delay the Gandhar project in any manner, according to IPCL officials. What is more, some of the downstream projects at Gandhar are likely to be joint ventures, which will further bring down the financial burden, IPCL officials said.

Meanwhile, IPCL has applied to the government a proposal to offer equity to the public. If approved, it will effect a revolution in the company's affairs, making it a market-oriented corporation from being primarily government-oriented. A similar proposal from Computer Maintenance Corporation (CMC) has been approved by the government. According to well placed sources, the government is under pressure from the World Bank to privatise large government-owned corporation and a resources-starved gov. has no alternative but to bow to the world body.

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PIB clears BPCL's n-paraffin project

The n-paraffins project of the state-owned Bharat Petroleum Corporation Limited (BPCL) which was beld up by the Public Investment Board (PIB) for well over a year, has now been cleared for consideration by the cabinet. The PIB, at its meeting recently has recommended to the cabinet the BPCL project for manufacturing 70,000 tonnes per annum of n-paraffins from Bombay High kerosene stream at its refinery in Bombay. The estimated cost of the project is put at Rs. 156 crores, including a foreign exchange component of Rs. 37 crores.,

The project is expected to be completed within 36 months from the date of government approval and would yield an internal rate of return of 22.7 per cent. The project has already been cleared from the environmental angle. The petroleum and chemicals ministry has to include it in its Eighth Plan outlay. The delay of over one year has led to an escalation in the project cost from Rs. 121 crores as on February 1989 to Rs. 156 crores now. The delay was the result of government indecision on whether it should supply kerosene to Reliance Industries Limited's linear alkyl benzene (LAB) project or force the company to use n-paraffin as the feedstock. LAB plants can either use kerosene as feedstock and convert it into n-paraffin or use n-paraffin directly. But the former route is more cost competitive particularly when the plant has its own facilities for converting kerosene into n-paraffin.

PIB considered the BPCL proposal in October 1989, but could not take any decision as the government was yet to decide on RIL's request for allotment of kerosene from BPCL. If it was decided that RIL should base its operation on n-paraffin obtained from BPCL, then that would establish a market for BPCL's project, it was argued. If, on the other hand, kerosene was to be supplied to RIL, then BPCL would have to provide adequate kerosene and also look for an alternative market for its n-paraffin.

The petroleum and chemicals ministry decided on October 31 that RIL would not be given kerosene for its LAB plant. Instead, it was asked to tie up with BPCL for its n-paraffin supplies. PIB met a day after to clear the n-paraffin project on the strength of this decision. Another factor that influenced PIB's decision was the fact that Gujarat Alkalies and Chemicals Limited had confirmed its decision to go ahead with their gas project. Thus, there would be no marketing problems for n-paraffin to be produced by BPCL.

MAHARASHTRA BANS SUB-STANDARD DRUGS

The Maharashtra Govt. has banned the sale and distribution of the following drugs as they were found to be of sub-standard quality, according to an official release. The names of drugs, batch number and name of manufacturer are Pancreatin tablets ST-12, the Pharmac Ltd., Madras, Hitacid —MKRC-17 and MRC-19, Hindustan Labs., Thane, Chlorpheniramine maleate tablets, USP — 1888, DEE CEE Labs., Gaziabad (UP), and Baralgan Inj. — 9001, Modern Lab Indore (M.P.). The manufacturers of the said drugs located in Maharashtra have been directed to stop sale of the said batches of these drugs, to recall the stock already sold, to intimate details of stock of the said batches and to stop manufacture of the drugs in question. The Drugs Controller of other States have been intimated to take appropriate action against the manufacturers located in their jurisdiction for manufacturing substandard drugs, the release said. Information regarding instances if any of sale or distribution of the said sub-standard drugs if observed by any one may be communicated to the Commissioner, Food and Drugs Administration, Maharashtra State, Griha Nirman Bhavan, for taking appropriate action in the matter, the release added.

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Chemical exporters plead for hike in CCS

If only major petrochemicals companies like IPCL, NOCIL, HOC, BPCL, etc. are to make available petrochemical intermediates like benzene, toluene etc. in sufficient quantities and fair prices for export production to downstream units, exports of many basic chemicals, pharmaceuticals and cosmetics could be increased sharply in the next four or five months.

But another important prerequisite for it is that the government must offset the increase in the production and packaging costs through a proportionate hike in the rate of cash compensatory support (CCS).

This was the consensus arrived at in a special meeting of a more than a hundred manufacturer-exporters — each accounting for exports worth more than Rs. 2 crores at Bombay on Nov. 6. The meeting was convened by Mr. Ramu Deora, chairman of the Chemexcil for finding out the specific problems confronting the major export-manufacturers, so that government could try to solve them expeditiously.

The Chemexcil has taken the initiative in this regard, following a suggestion made by the commerce ministry a few days ago. Many export-manufacturers also pleaded for empowering the state authorities to produce and export drugs, which are not registered in India.

Some others urged Chemexcil to provide market intelligence in Japan and the U.S. for petrochemicals, to intermediates exporters, as the Gulf crisis has completely disrupted the traditional market. It was also pointed out that value-addition of as much as 25 per cent for high-value bulk drugs was a difficult norm to achieve.

If only the government cared to reduce the value-addition norm to a more reasonable level, Indian bulk drug companies would be able to hike exports by an additional Rs. 50 crores. Chemexcil members pleaded for storage of bulk-imported solvents in bonded warehouses for retail supplies to export manufacturers. Individual units are not in a position to import the solvents in small quantities to meet their needs, it was pointed out.

They also urged the government to permit them to do trading activities, i.e. import goods from general currency countries (GCA) if only for re-export to other GCA countries, all for a profit. For this purpose, the government should also reduce the level of value-addition norm.

"The government should further initiate a scheme of blanket advance licence to import any goods unrelated to exports. It should be enough that at the end of the day, the licence-holders should come up with a net balance in foreign exchange earnings. Only such drastic measures can help in overcoming the present difficult balance of payments situation", an exporter pointed out.

Cost of export of drugs and pharmaceuticals has risen considerably following a 35 per cent increase in prices of ampoules and glass bottles , thanks to the petroleum price hike.

Only a corresponding hike in CCS could offset this cost factor. Many manufacturers also complained that ethylene oxide supplies from IPCL have become skimpy affecting their exports.

Some manufacturers of pesticides pleaded that the government's gesture of exemption from 15 per cent cut in supply of petroleum products to export-manufacturer should also be extended to other chemical manufacturers who cater to the domestic market "because, in a sense, the latter is only engaged in import substitution activty".

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Gujarat Glass, Nicholas Laboratories to merge

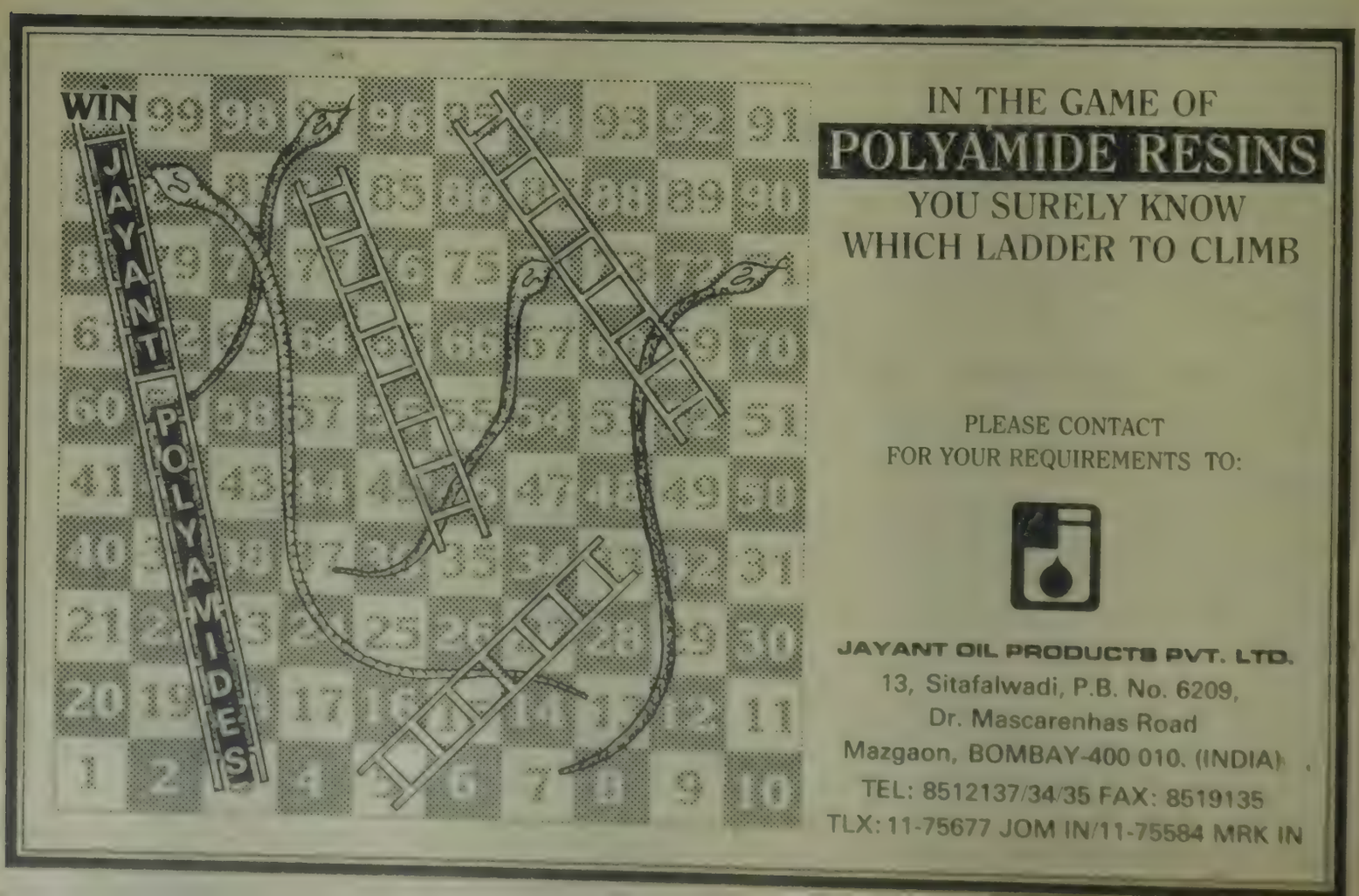
The board of directors of both Gujarat Glass Ltd. and Nicholas Laboratories have approved the proposal to merge the two units to create a large, diversified company whose turnover will exceed Rs. 100 crore by March 1992. The merger scheme, invloving the issue of one share of Nicholas for every two shares of Gujarat Glass, will be put up for the approval of the shareholders of both companies in the near future.

Since both companies effectively operate in the business of health care and related businesses, considerable operating synergy will be derived from the merger, according to Mr. Ajay G. Piramal, vice chairman. Both belong to the Piramal group. Packaging constitutes around 15 per cent of the input cost of pharmaceutical products. In addition to spreading the risks of both the companies by becoming a multi-location, multi-product unit, it will also provide the merged company access to resources to overcome any temporary fluctuations in the business cycle in their respective fields, Mr. Piramal said.

Gujarat Glass manufactures glass containers primarily for the pharmaceutical industry. The company recently went public with an equity issue of Rs. 1.5 crore to finance a Rs. 19-crore expansion project. The current equity capital of the company is Rs. 330 lakhs. With the implementation of expansion by March 1991, in a full year's working, the company's turnover will increase to Rs. 40 crore as against its existing turnover of around Rs. 24 crore.

Nicholas makes pharmaceutical formulations and personal care products. Nicholas was acquired by the Piramal group in 1988 from Aspro Nicholas group of UK. Since its takeover, in the first 21 months of its operations till March 1990, the company's turnover has grown by 49 per cent to Rs. 29 crores. It is expected to exceed Rs. 40 crores during the current year. Though the company is expanding its product range, there are apprehensions that the long-term prospects may be affected by environmental factors not conducive to the drug industry. In this connection, Mr. Piramal mentioned increasing the number of price-control drugs, disallowance of price increases as per DPCO, re-activating of DPEA and uncertainty of drug policy.

Nicholas is investing Rs. 12 crore for expanding its facilities at Pithampur, which will go on stream in mid-1991. It has also tied up with Allargan International of the US for marketing their intra-ocular lenses in India. Gujarat Glass is also strengthening its base in the glass container market.



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Pesticide export may touch all-time high

Pesticide exports from India are likely to touch an all-time high with an increase of 65 per cent over last year. Pesticide exports have multiplied from Rs. 39.16 crore in 1987-88, to Rs. 61.02 crore in 1988-89 and is expected to be around Rs. 100 crore in the current year. The imports, on the other hand, have been scaled down to Rs. 25 crore.

For a country which had relied mainly on imports during the 70s and 80s, finding a strong foothold in the international market assumes significance. Executive director of Pesticides Association of India S.C. Mathur says, " There appears to be a great demand for pesticides from India. In the years to come, you will see that India will emerge as a major exporter of pesticides".

A bulk of the exports now are going to the Middle East, Sri Lanka, Pakistan, Bangladesh, Hongkong, Singapore and Thailand. The pesticide industry has also succeeded in marketing a sizeable quantity of chemicals to USA, USSR, Japan, France, Australia, the Netherlands, Spain, Belgium, Italy, the Philippines, Taiwan and even to Germany. In 1988-89, nearly Rs. 2.77 crore worth of nicotine sulphate was exported to Japan, Rs. 2.31 crore worth of aluminium phosphate, a chemical whose use is restricted in India, was exported to West Germany, USA, France, Australia, USSR and many Middle East countries. Malathion, a substitute for DDT, has found a market in France, Yugoslavia, Belgium, Italy, Poland and in certain other South-East Asian countries. Among the other chemicals being exported are nicotine alkaloids, lindane, zinc phosphide, BHC dust and quinalphos.

An important development has been the export of technical material of chemicals. So far, production of technical material was considered to be the prerogative of the western countries, India has lately demonstrated its ability to go in for quick imitations of these at cheaper costs.

The industry has, meanwhile, asked the government to ban the import of pesticides for which an adequate indigenous manufacturing capacity exists. Thirteen pesticides, including BHC, malathion, isoprouron, endosulfan, monocrotophos and butachlor, have been listed by the PAI. The association has urged that in case it is difficult to ban the imports a uniform customs duty of 105 per cent be levied.

At the same time, the industry has called for a reduction in the import duty (not customs duty) to 70 per cent ad valorem. It emphasised on the need to impose a customs duty of 105 per cent on the import of locally produced technical grade pesticides to prevent dumping of these chemicals by foreign companies. The government had so far gone in for upward revision of customs duty for only three of such chemicals.

PESTICIDES TO BE BROUGHT UNDER PMP

The pesticides industry is to be brought under the phased manufacturing programme (PMP) soon to promote greater efforts towards indigenisation. According to Mr. M.S. Gill, Secretary, in the Department of Petrochemicals and Chemicals under the Petroleum and Chemicals Ministry, the phased indigenisation plan (as he termed it) for the pesticide industry is to be worked out on the lines of that already operating in the pharmaceutical industry and the issue of licensing is to be linked to it. Disclosing this at the annual general meeting of the Pesticides Association of India at N. Delhi on Nov. 12, Mr. Gill said that although there were constraints involved and many of the pesticides were closely-held technologies, the industry should think in terms of a more basic stage manufacture so that the country benefited in real terms in foreign exchange savings.

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Fertiliser imports through Calcutta Haldia ports fall

Despite 12 to 15 per cent average annual growth of fertiliser consumption in eastern states, imports of fertiliser through the ports of Calcutta and Haldia are showing a downward trend. This is because the agriculture ministry, which finalises fertiliser imports, has not succeeded much in its bid to prevail upon the Transchart, the chartering wing of the shipping ministry to nominate suitable vessels for these ports.

The ministry's allocation of imports to these ports has not only been less than the previous year, whatever precious little has been allocated is not being made available to them. During the period from April to September this year, the ministry allocated 26,000 tonnes of finished fertilisers for Calcutta dock system and 66,000 tonnes for Haldia dock but the actual availability during the same period was to the tune of 6,000 tonnes and 42,000 tonnes respectively. The import of raw materials for fertilisers such as rock phosphate and sulphur presents no different picture. In first six months of the current financial year (April to September 1990-91) Calcutta was allocated 113,000 tonnes and Haldia 392,000 tonnes of fertiliser raw materials. However, their actual availability during the period did not exceed 80,000 tonnes and 116,000 tonnes respectively.

Compared to other ports, the allocation of finished fertilisers to Calcutta/Haldia for the period under review was much less. Thus during the first six months of the current financial year Calcutta and Haldia together were allocated a total of 74,000 tonnes against 130,000 tonnes for Vizag, 150,000 tonnes for Madras, 93,000 tonnes for Kandla and 184,000 tonnes for Bombay and Jawaharlal Nehru port taken together. What has been particularly upsetting for Calcutta/Haldia is that the actual availability to other ports was more than the allocations made. Thus, during the period from April to August this year, the actual handling by Vizag was 197,000 tonnes against 135,000 tonnes during the same period last year, by Madras 206,000 tonnes (128,000 tonnes), by Kandla 144,000 tonnes (100,000 tonnes) and Bombay/JNPT 195,000 tonnes (67,000 tonnes). During the period, Calcutta/Haldia actually handled 41,000 tonnes against 142,000 tonnes in the same period last year.

The failure of the agriculture ministry to make available suitable fertiliser vessels for Calcutta/Haldia to meet fertiliser requirements in the hinterland of these ports is not only affecting the two ports but also costing the government a lot. Since fertiliser movement involves subsidy by the government, the longer the distance between the port of discharge and the centres of consumption, the higher will be subsidy amount. In other words, by unloading fertilisers meant for eastern states at some distant ports, the government is actually paying through its noses.

The argument that suitable vessels cannot be located for these ports because of draught restriction is, according to CPT sources, untenable. Transchart has been furnished with a list of 3,000 dry bulk carriers from Lloyd's Register to show that these vessels are ideally suitable for Calcutta and Haldia. Besides, there are another 50 vessels under Indian flag which too could call at these two ports without much difficulty.

EFFICIENT USE OF POTASH STRESSED

Maximisation of efficiency of potash required for plantation crops should receive all attention from researchers to help save valuable foreign exchange. This was the observation of Dr. J.S. Kanwar, deputy director-general of ICRISAT Hyderabad. Inaugurating a three-day symposium on potassium for plantation crops, he said the efficiency maximisation would help reduce the import bill. The country meets its potassium requirements entirely through imports. He said limited land resources and increasing food needs necessitated realisation of maximum potential. The Potash Research Institute of India should monitor the changing scenario of nutrient status in the plantation crops and evolve time series data for planning purposes, he added.

Dr. Kanwar said the strategy paper for the Eighth Plan had paid very little attention to the nutrition needs of plants. This was a serious omission, he said. Similarly, soil and water management also received inadequate attention in the paper which only concentrated on plant improvement, area extension and plant protection.

Dr. P. Rathnam, assistant director-general of Indian Council of Agriculture Research (ICAR) said exports of plantation crops was seven per cent of the total exports and earnings from tea alone amounted to Rs. 600 crore, Oil palm cultivation had taken and off in the country in Karnataka and Andhra Pradesh offered potential to bring 5.75 lakh hectares of land under palm cultivation. A major portion of edible oil needs could be met through palm oil generation, according to Dr. Rathnam.

INDIAN PHARMACEUTICAL CONGRESS POSTPOMENT

Due to recent disturbances in various parts of the country, many pharmaceutical professionals were not able to register in time for the 42nd IPC at Manipal. In view of this fact, Local Organising Committee of the 42nd I.P.C. is extending the last date of Registration upto 30th November 1990. Those who desire to register for the 42nd IPC are requested to send the filled Registration form with required amount at the earliest to the Chairman of Registration Committee.

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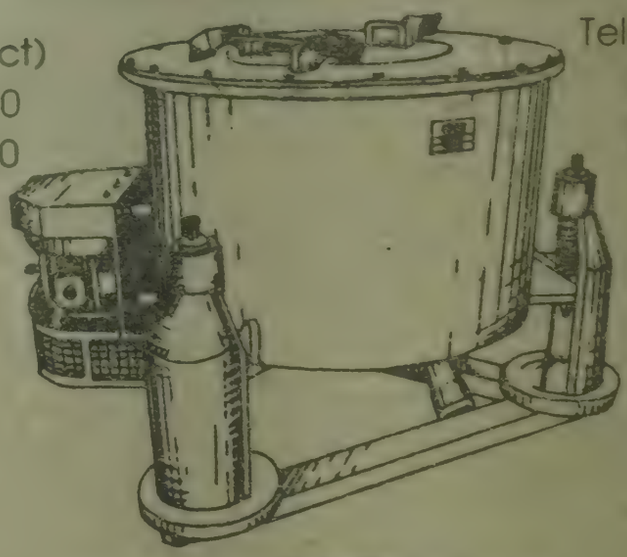

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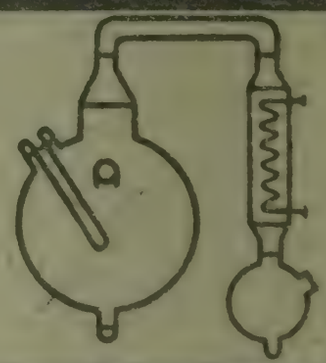

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GAIL moots gas-based fertiliser units abroad

The petroleum department has made out a strong case for setting up gas-based fertiliser projects abroad with a view to allocating the methane fraction of indigenous gas to other competing sectors such as power and sponge iron industries.

Building the case on the basis of a 'desk study' conducted by Gas Authority of India Limited (GAIL), the department says: "Indian-owned fertiliser complexes, fully dedicated to the Indian market, but set up offshore, can produce fertiliser at a fraction of the current cost. This would not only permit us to secure cheap fertiliser, but also release indigenous gas for power generation which is essentially not tradeable".

The department, in a recent note on the subject, points out that the foreign exchange cost of externally produced fertiliser would not be much higher than the foreign exchange cost of indigenously manufactured nutrients. India is a net importer of petroleum and as domestically produced gas is a perfect substitute for naphtha, its cost is equivalent to the cif price of imported naphtha.

According to a GAIL study it is possible to build a $ 1.6 billion complex in West Asia where gas is very cheap. The complex will comprise four urea plants of 2,250 tonnes per day (TPD) capacity and facilities for extraction of LPG and natural gas liquids (NGL).

Assuming a feedstock cost of $ 0.80 per million British Thermal Units (BTU) and fertiliser transportation cost at $ 18 a tonne for a West Asian complex, the study reckons a cif price of $ 181 a tonne for urea in case two units are established. If four urea plants are set up instead of two, the cif cost of urea will decline to $ 167 a tonne. In case LPG and NGL are extracted, the economic cost of fertiliser production would be reduced further to $ 154-168 per tonne. The study, on the other hand, has put the foreign exchange cost of locally produced urea at $ 163 tonne and total production cost of at Rs. 336 a tonne.

GAIL points out that even with substantial cost overruns and increase in gas price, the economic justification for offshore projects remains strong according to the "sensitivity analysis" given in the study. The petroleum department says that the cost of production in an indigenous gas-based urea plant is Rs. 6,000 a tonne, compared to the farm-gate price (retail price) of Rs. 2,250 a tonne. The offshore fertiliser units on the other hand, will produce urea at a price close to Rs. 2,250 a tonne, thereby facilitating an annual subsidy saving of Rs. 1,000 crore for a four-unit complex. The financing of the proposed complex can be structured in a manner which would not impose a large foreign exchange burden on the economy.

It should be possible to secure adequate credit from multilateral agencies and foreign commercial banks. Working on a debt-equity ratio of 3:1 with an Indian investment of $ 400 million, it should be possible to set up a $ 1.6 billion complex of four fertiliser units and LPG and LNG extraction plants. It is pointed out that the economic cost of gas is Rs. 2,250 per million standard cubic metres in the country, compared to Rs. 280 per MSCM in gas-rich nations. Despite such adverse comparative costs, the government has consciously exercised the high-cost option of indigenous production. This is because being one of the largest fertiliser consumers, it may be imprudent for India to rely on imports as it would over-expose the economy to erratic movement in international prices of urea. A lower cost option is available wherein we can access cheap gas in West Asia and yet safeguard ourselves against market oscillations.

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Phosphoric acid import likely

The Union government is likely to give the green signal for import of eight lakh tonnes of phosphoric acid worth around Rs. 500 crore.

The steering committee on the import of fertiliser in which the ministries of commerce, finance, agriculture and the Minerals and Metals Trading Corporation are represented, is expected to meet in the next few days to clear the long-pending proposal. Earlier, imports were held up because of the finance minister's refusal to allocate the necessary funds on the account of the severe foreign exchange crunch.

According to official sources, the department of fertilisers and the commerce ministry have made a strong plea in favour of phosphoric acid imports along with the required quantity of ammonia. The imports are being justified on the ground that given the relative international price movement, buying acid and ammonia will turn out to be cheaper than importing the end product, diammonium phosphate (DAP), at a later date.

Also relevant is the serious repercussion that shortage of phsophoric acid is likely to have on ten fertiliser units which make complex fertilisers based on imported acid. Already, plants have started closing down on account of shortages. Godavari Fertilisers and Chemicals have closed down while others are expected to shut down shortly.

According to sources, the exercise to import the required eight lakh tonnes of acid for the second half of the current financial year should have been undertaken by end-July or early August. Even if a decision is taken immediately to import fertilisers, import can land in the country only by mid-December. Shortages of phosphatic fertiliser is expected to hit farmers in the rabi season itself. The peak demand period for the fertiliser is during the months of November and December.

The units which will be affected are the Kandla unit of IFFCO, Goa plant of Zuari Agro, Madras unit of MFL, Sikka plant of GSFC, Hindustan Lever Haldia outift, Paradeep Phosphate's plant at Paradeep, Godavari Fertiliser's unit at Kakinada, NCFL's Mangalore plant and the Tuticorin and Alwaye units of SPIC and FACT respectively.

It is argued that the question of unutilised domestic capacity should be taken into account while determining the cost benefit of importing DAP at the expense of acid.

According to prices ruling in the international market in the third week of October, the value of domestically produced DAP with imported acid and ammonia works out to $ 226.62 which is cheaper than importing DAP direct.

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$160 m ozone layer fund for Third World

An interim multilateral fund of $160 million (nearly Rs. 300 crore) would be set up shortly under the Montreal protocol to help developing countries phase out in the next ten years or more chemicals that damage the ozone layer. The exact operational details of this funding mechanism would be decided once the major amendments to the protocol, agreed to at the ministerial level meeting in London in June comes into force, official sources said.

The fund is to be increased by another $80 million (about Rs. 144 crore) if developing countries like India and China join the protocol, the sources said. Ms. Maneka Gandhi, the then Minister for Environment had made out a strong case for India joining the group since developed countries had agreed to remove discriminatory clauses against the third world. The matter is still awaiting formal approval from the government.

The Government approval for signing the protocol has apparently taken a ''back seat'' due to the current political situation in the country, sources said. The relevant papers are now pending with the Union cabinet for approval, the sources said.

World Bank will implement a major portion of the fund while the United Nations Development Programme and the United Nations Environment Programme will handle the remaining part of handling the funding programme. The funds are to be raised through contributions from the developed countries. The fund would be administered by a seven member executive committee and its chairmanship would rotate between two groups annually, the sources said.

Establishment of the fund follows a major victory for developing countries which have incorporated an amendment for the first time in an international treaty making clear that developing countries require new and additional funds for cleaning up the environment messed up by the industrialised world, the sources said.

The interim fund is to be operated for a three-year period between January 1, 1991 to December 31, 1993. It will be replaced by a permanent fund which may have a larger capital base, the sources said. The funds are to be made available in addition to the existing levels of overseas development assistance to developing countries.

The funds would be made available to the developing countries as grants or concessional loans depending on the economic feasibility of the projects to be undertaken under the protocol. The sources said whether India takes early or late steps to comply with the Montreal Protocol, the present value of the ''incremental costs'' of phasing out the chemicals that damage the ozone layer would range from Rs. 900 crore to Rs. 1,500 crores for the Indian economy in the next 20 years, that is till 2010.

The range of incremental cost is subject to availing certain discount rates which vary between eight to 12% which is again linked to an either early or late phase out within the stipulated period under the protocol for the developing countries, the sources said.

Incremental cost, the sources said, is defined as the cost to be borne by the Indian economy over and above the cost which would have been borne anyway to produce and use conventional chlorofluoro carbons (CFC) and includes cost of switch over by CFC producer industry, CFC user industries like the refrigerators and air-conditioners.

These projections are highly tentative as they are based on a number of assumptions regarding costs of new substances and technologies, some of which are still in the development stage. Although similar studies have been initiated in other countries such as China, Mexico, Egypt and Kenya, India's is the first study to go into some detail about the total economic implications, the sources said.

According to an Indian consulting firm as well as a British firm's estimate of the pattern of growth of Indian industry in the next two decades, the demand for CFC may reach as high as 1.70 lakh tonnes by 2015.

INVESTMENT CLIMATE BAD

The investment climate in the country deteriorated during the first half of 1990, according to FICCI. In a review of the current economic situation undertaken by FICCI, it is maintained that the number of industrial licences issued during January-June 1990 fell by 19.5 per cent. Letters of intent issued declined by 15.4 per cent over the same period in 1989. Also, financial assistance sanctioned by the term lending institutions dropped from Rs. 2,602 crores to Rs. 1,590 crores.

However, there were some positive indicators, as well. Total foodgrains production is expected to increase by 7.82 million tonnes during 1990-91, and the food stock position will provide better demand support to industry. The index of industrial production increased by 13.1 per cent during the first quarter of 1990-91 following better performance by the manufacturing sector.

ONGC PLANS TO CUT GAS FLARING

In its desperate bid to step up the utilisation of natural gas the Oil and Natural Gas Commission (ONGC) has embarked upon schemes whereby it should be possible to achieve zero flaring by 1993-94. However, the success of the schemes which presupposes making gas available at the doorstep of prospective consumers, will depend to a great extent on the high degree of coordination and synchronisation in the overall planning exercise.

British Prime Minister urges swift action on global warming

The British Prime Minister Mrs.Margaret Thacher on Nov. 7 urged swift action to draw up an international convention to combat global warming. Speaking at the opening of the ministeral meeting of the World Climate Conference in Geneva, the British Prime Minister conceded that the margin of error in scientific findings meant that climate change might be less severe than forecast. Equally, it could occur more quickly than the present computer models suggested.

"Should this happen it would be doubly disastrous were we to shirk the challenge now", she said. Mrs. Thatcher was speaking to environment ministers and some heads of state from 140 countries. The conference, arranged by the United Nations environment programme and the International Meteorlogical Organisations, aims to begin work on a global climate convention which would be completed at another international meeting in Brazil in 1992.

Mrs. Thatcher's speech was greeted unenthusiastically by environmental groups, which said it offered nothing new. She was cautious about the accuracy of the scientific knowledge indicating the scale of the threat, but said "The need for more research should not be an excuse for delaying much-needed action. There is already a clear case for precautionary action at an international level".

She saw it as a global insurance policy "It may be cheaper or more cost-effective to take action now than to wait and find we have to pay much more later". The US was still refusing to declare targets for reducing its emissions of carbon dioxide, the main greenhouse gas.

The US and the Soviet Union are among the few industrialised nations which have declined to give such commitments. Dr. Mostafa Tolba, director of UNEP, has held talks with the US delegation and is optimistic the US will eventually shift its position and announce targets. But this is not likely to occur when the Americans outline their position today. It is expected they will give targets when a further meeting is held by officials in Washington in February. Mrs. Thatcher made it clear that different countries must be allowed to choose different targets for greenhouse gas reductions. Dr. Tolba said science showed that climate change was now beyond reasonable doubt. He called for a "legally binding treaty with specific commitments with clout".

EXPERTS CALL FOR STUDIES ON GLOBAL WARMING

Calls for better studies of the consequences of global warming, such as changes in sea level and of a reduction of gas pollution responsible for the so-called greenhouse effect were made at the opening of the second world conference on the climate, at Geneva recently.

The conference, organised under the auspices of the United Nations, is being chaired by Zou Jingmeng, the President of the World Meteorological Organisation, which is one of the six participating international organisations. More than 500 scientific experts were due to exchange information and findings on the uncertain scale and consequences of climatic changes. After a ministerial meeting in early November due to be attended by several heads of State or of Government, including British Prime Minister, Mrs. Margaret Thatcher, French Prime Minister, Mr. Michael Rocard, and King Hussein of Jordan, the conference was due to adopt a declaration on action to be taken to combat the negative effects of global warming.

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Rich lifestyles threaten earth's climate

The high-consumption life-style of the world's richest billion people in America causes immense environmental problems, according to the World Watch Institute. Each day, for instance, the typical American consumes most of his or her own weight in basic fuels, minerals and agricultural and forest products.

Changes of values will ultimately be needed both for personal fulfillment and to keep human demands from exhausting the earth, says senior researcher Alan Durning of the Washington DC-based Policy Research Organisation.

The world's top echelon described as the car drivers, beef eaters, and throw-away consumers, pumps out more than half of the greenhouse gases that threaten the earth's climate and almost 90 per cent of the chlorofluorocarbons that destroy the earth's protective ozone layer. Since 1950, per capita energy use in the U.S. has climbed 60 per cent, car travel has more than doubled, plastics consumption has multiplied 20-fold, and air travel has jumped 25-fold.

Other features of the consumptive lifestyle include.

* Americans now drink more soda pop in throwaway containers than water from the kitchen sink.

* Producing a pound of American steak requires five pounds of grain and the energy equivalent of a gallon of gasoline.

* Each year, Americans toss enough aluminium cans to make about 6,000 DC-10 Jet airplanes.

* Japan throws away 30 million disposable single-roll cameras a year.

* The world's auto class is responsible for 13 per cent of carbon dioxide emissions from fossil fuels worldwide, along with high proportions of air pollution and acid rain. The automobile lifestyle also causes a quarter million traffic fatalities annually, as well as the sprawl of urban areas into endless tract developments lacking community cohesion.

ALUMINIUM INGOTS PRICES RAISED

Aluminium producers have jacked up the basic price of ingots by Rs. 2000 to Rs. 33,750 per tonne. This is the third price rise in aluminium after price and distribution controls were removed in March 1989. The industry is expected to revise the prices of rolled and semi-fabricated products shortly.

User industry apprehends that with aluminium prices moving up, there is every possibility of consumer resistance as it will be difficult to absorb the price increases.

Aluminium producers have jacked up prices on the plea that there has been an all-round increase in production costs, with most State electricity boards revising tariffs upwards, power costs have gone up considerably. Being a high-tension industry, power consumption is high in aluminium.

The industry is also affected by the revision in fuel prices in the wake of the Gulf crisis. Industry sources point out that aluminium was decontrolled especially as it was felt that after commissioning NALCO (2.18 lakh tonne capacity), there would be a perceptible improvement in availability of the metal locally.

NALCO is reportedly exporting ingots and sources suggest that exports should not be at the cost of starving the domestic units. Some even question the basis of exporting ingots instead of going in for value added products.

It is pointed out though there is no shortage of the metal at present, the supply position is not very comfortable as often one has to wait for days before getting physical supplies.

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ONGC bid to step up gas utilisation

In its desperate bid to step up the utilisation of natural gas, the Oil and Natural Gas Commission (ONGC) has embarked upon schemes whereby it should be possible to achieve zero flaring by 1993-94. However, the success of the schemes which presuppose making available gas at the doorstep of prospective consumers will depend to a great extent on the high degree of coordination and synchronisation in the overall planning exercise.

As ONGC sources emphasise, there is need to ensure commissioning of downstream facilities on time as also close monitoring on the part of various agencies to ensure the offtake of committed quantities of gas and expeditious approval of gas-based projects.

ONGC's concern to step up the utilisation level of gas is under-standable. The present gas production is 45 million cubic metres a day. At the current level of production, the wastage is more than one-third of the production. In western offshore alone, about 15 million cubic metres of gas is flared every day. Unless corrective steps are taken immediately, the flaring figure will be even higher in coming years. The Eighth Plan envisages a two-fold increase in gas production from the present level of about 45 million cubic meters a day.

During the past five years, gas reserves increased five folds, yet the demand did not pick up as much. This was mainly because of the delay is commissioniong of downstream facilities and inadequate offtake of committed quantities by consumers. Perhaps the most important had been the need to upgrade the transport infrastructure. A network of pipelines in the form of grid at the regional as well as national levels therefore seems almost unavoidable. The ultimate aim, as ONGC sources point out, should be bringing about an increased involvement of gas to use gas as substitute for middle distillates. There is a further need to study more closely, the linkages between various energy sectors and work out a long-term gas development plan, the sources add.

OIL INTAKE IN SOUTH DECLINES

Thanks to austerity measures in the immediate wake of the Gulf crisis, the diesel oil and petrol consumption in the southern region came down by as much as 10.35 per cent and 6.52 per cent respectively in September, compared to the average of the previous five months, well before the supply cut was formalised.

The cut in supply of petroleum products was announced on Oct. 12, while the prices were hiked on Oct. 14, but the reduction in distribution by the four corporations — Indian Oil, Bharat Petroleum, Hindustan Petroleum and IBP, had its effect much earlier.

With the cut more stringent now, retail outlets could well end up putting up 'no stock' boards by the 25th of any given month, sources in industry feel.

According to official figures, Andhra Pradesh turned in the most desired results, the decrease in diesel oil consumption in September as against April-August coming to a remarkable 17.44 per cent. The performance for petrol was equally good, at 8.65 per cent cut. Karnataka too did well in reducing consumption, the figures for diesel oil and petrol being 10.42 per cent and 9.65 per cent respectively, while Kerala recorded 7.05 per cent and 4.33 per cent.

The only southern state which did not turn out impressive cut figures was Tamil Nadu, which was the largest consumer during the period of both diesel oil and petrol in the region. This State managed only a 3.38 per cent cut in petrol use, while diesel was slightly better at 6.05 per cent.

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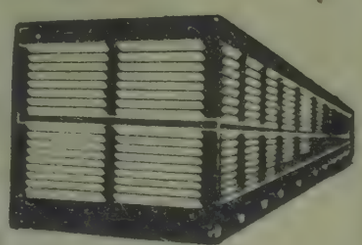
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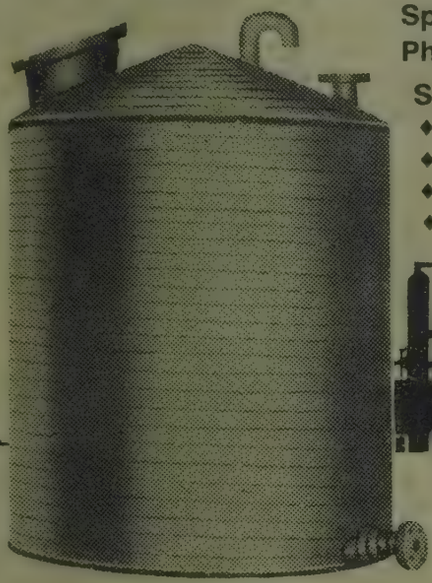

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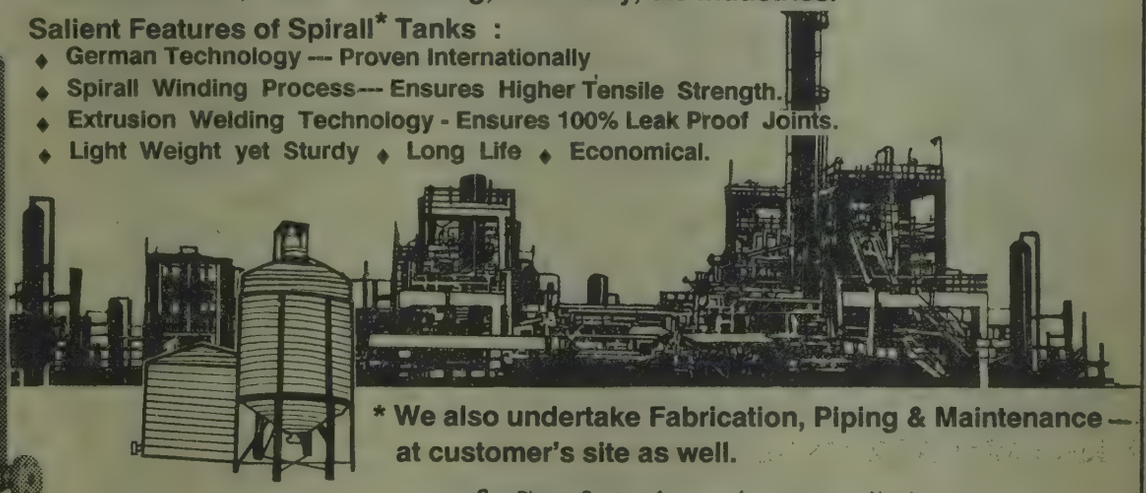

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11% rise in world's gas reserves

The world's established natural gas reserves this year have increased by more than 11 per cent over that of last year.

On January 1, 1990, the reserves stood at 129,297 billion cubic metres, as against 115,725 billion cubic metres on January 1, 1989.

This represents an increase of 11.7 per cent, according to the *Arab Oil and Gas Review*, quoting the International Information Centre on Natural Gas and All Gas Hydrocarbons (CEDIGAZ).

A total of 40.7 per cent of the gas reserves are situated in Eastern Europe, of which 40.2 per cent are in the USSR, a country whose established reserves increased by 9,500 billion cubic metres last year to 52,000 billion cubic metres. Iran, the country with the world's second largest volume of reserves, announced an increase in established reserves of 2,800 billion cubic metres in 1989. The share of West Asia in the world gas reserves decreased from 29.7 per cent of the total to 29.2 per cent and that of Africa from 6.7 per cent to 6.4 per cent, despite respective increases of 9.8 per cent and 5.5 per cent in absolute figures.

Natural gas today accounts for some 21 per cent of the world's primary energy consumption as against 17 per cent in 1970, with oil products accounting for 37 per cent, coal — 30 per cent and primary electricity (hydraulic, nuclear) — 12 per cent.

Meanwhile, the fourth international oil seminar organised by the Franco-Arab Chamber of Commerce and the Arab Centre for Oil Studies (Arab Oil and Gas) will be held at Paris from 17-18 December 1990 on the general theme "The Gulf crisis and its impact on oil and gas markets".

The seminar will be attended this year by Mr. Sadek Boussena, Organisation of Petroleum Exporting Countries (OPEC) Chairman and Algerian Minister of Mines and Industry, and other high-ranking officials from OPEC countries and representatives of the International Energy Agency (IEA) and the European Economic Community.

The price of crude oil is settling down at around 33 to 35 dollars a barrel. Even though last week of October crude prices in the U.S. witnessed a record fall they managed an equivalent comeback.

Particularly, in the last week of November the equations have tapered off to smaller quantums. Recently one barrel of U.S. benchmark West Texaco intermediate crude for December delivery has hovered around the $34 mark. Analysts said that recent price range offers more or less a stable point, which in the event of a continued standoff (no resolution) to the Gulf crisis and no major change in military situation might be the marker for the months to come. (It may be noted, however, that the World Bank in a report said oil prices could decline, going by September trends).

Traders say uncertainty about the future of the Persian Gulf situation persists and prices should not be expected to scale down. The never-ruled-out military confrontations has settled a fear-wave that outbreak of hostilities to translate into oil shortfall.

High oil prices for the third consecutive month have taken a toll on the U.S. and global economy. Few reports bring hope that economy has not lost all ground, while most statistics predict a gloomy period ahead. The trickle-down impact on the average American is becoming more visible. A report said that the one per cent rise in spending in September month virtually all went to paying for higher energy costs for high oil prices. On the other hand, savings rate for September fell to the lowest in three years at three and a half per cent.

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Clearance for ONGC oilfield project

The Cabinet Committee on Economic Affairs (CCEA) has cleared the Neelam and Mukta oilfields development projects, costing over Rs. 2,475 crores. The projects will be undertaken by the public sector Oil and Natural Gas Commission (ONGC).

The Mukta and Neelam fields, to be developed near Bombay are expected to be among the major contributors to oil and gas production from the western offshore region during the Eighth Plan period. A target of about 30 million tonnes has been set for the entire plan period from the western offshore region, which also includes other fields such as Bombay High, Panna and Heera. While the Mukta oilfields, whose development is estimated to cost about Rs. 395 crores have geological reserves of about 75 million tonnes of oil and oil-equivalent gas, the Neelam oilfields have reserves of about 150 million tonnes. The Neelam oilfields development is estimated to cost about Rs. 2,080 crores.

The annual production of oil from these two fields is expected to be around six million tonnes, at peak production rates. Of this Mukta is estimated to contribute to the extent of two million tonnes and Neelam the balance four million tonnes. The Mukta fields are also expected to generate about 1.4 cubic metres of gas per day. The Neelam oilfield, which is located about 45 kms south-west of Bombay, has been producing oil since March this year at a rate of about 10,000 barrels a day. It is expected to produce about 11.5 million tonnes of oil during the entire Eighth Plan period.

Production at the Neelam fields are currently being done with temporary deck facilities for four wells, from where well fluids are being sent to the adjoining Heera field for processing, through a subsea pipeline. However, now that the full development plans have been cleared, ONGC will drill about 100 oil wells and connect them to 12 well platforms, from where they will move further on to the process complex. The process complex is envisaged to have a provision for water injection facilities from the beginning itself, to maximise recoveries. It is expected to cost about Rs. 800 crores.

ONGC also proposes, at a later stage, to construct two water injection platform complexes for oil and gas processing besides a network of submarine pipelines for well fluids. The process complex is being designed to handle oil of upto six million tonnes annually, while the water injection platform will handle about 2.3 lakh barrels of water a day.

The Mukta oilfield is a cluster of B-57 and B-19 structures, discovered in August 1981 and April 1989, respectively. A total of 13 exploratory wells have been drilled so far on the two structures. A Rs. 76-crore project for development of the B-57 filed was cleared earlier. Located about 110 kms north-west of Bombay, the Mukta field is said to be a complex one, for both geological engineering and reservoir engineering.

ONGC which has already invited tenders for some work and equipment connected with the two projects, plans to implement them through internal resources. Besides development of new oilfields, ONGC also proposes to develop two offshore structures in Bombay High, with an investment of more than Rs. 3,000 crores. The negotiations are currently on with the visiting World Bank team for funding of these projects. The two projects will contribute another one million tonnes of oil besides ending the current flaring of gas.

According to ONGC, about 3.4 million tonnes of oil reserves have been established already in the commercial category, of which about 30 per cent are [illegible] produced about 350 million tonnes out of these recoverable reserves. Sources in the petroleum ministry point out that the oilfields development assume significance in view of the anticipated rise in demand of crude in the coming years. It is estimated that demand for oil by the end of the Ninth Plan is estimated to cross the 100-million mark by the end of the Ninth Plan. While the refining capacity is also being raised, the country should aim at meeting oil demand, to the extent of 90 per cent, from domestic sources.

At present, about 60 per cent of the oil demand is met through imports which results in a severe strain on the balance of payments situation. Besides the Mukta and Neelam oilfields, ONGC is planning to develop the Panna oilfields. The development of Panna oilfield involves an investment of about Rs. 1,200 crores and the field is estimated to yield about three million tonnes of oil every year.

BPCL PRESENTS RS. 10-CRORE DIVIDEND

Mr. R.K. Gajree, chairman and managing director of Bharat Petroleum Corporation Limited, presented a cheque of Rs. 10 crore to petroleum and chemicals ministry towards dividend for the year 1989-90 against the last year's dividend of Rs. 5.57 crores.

Besides dividend, the Corporation has issued bonus shares of Rs. 22.15 crores to the Government of India. The dividend of Rs. 10 crores is on the increased capital of Rs. 50 crores, maintaining the same rate of 20 per cent. Apart from the above, the company has contributed Rs. 1,051 crores to the exchequer by way of taxes and duties.

The company has invested over Rs. 200 crores in capital projects during the year, bringing the total investment to over Rs. 1,300 crores, mainly out of internal resources, since take over of the

GAS DEVELOPMENT

IBRD to aid ONGC

The World bank is to assist the Oil and Natural Gas Commission in implementing its different gas development projects. The total cost of the projects is estimated at more than Rs. 2,000 crores (US $ 1,194 million). The World Bank has agreed to part-finance the project to the export of about US $ 295 million (Rs. 500 crores approximately). The World Bank loan is to close on June 1993. The repayment period extends over 20 years, including a grace period of five years.

Categorywise allocations of the World Bank loan will be as follows: Process facilities, $ 76 million; pipeline system including installation, $ 60 million; drilling material equipment $ 61 million; drilling services $ 70 million; seismic survey $ 8 million; and engineering studies $ five million. Unallocated portion of the fund constitutes $ 15 million.

The projects to benefit from the World Bank assistance are all located in western India. These include the south Bassein Phase I, Heera-Uran pipeline, Gandhar/Dahej fields and Hazira/north Tapti fields.

The development of south Bassein Phase II, estimated to cost Rs. 590 crores, comprises construction of a gas processing platform with gas and condensate treatment facilities for the additional production capacity together with power generation facilities, workshop and a control centre, construction of a nine-slot wellhead platform, construction of a flair structure and tie lines and drilling of 27 development wells and installation of an onshore gas processing facility and offshore terminal at Hazira.

The Heera-Uran pipeline has been commissioned to transport 1.5 million cubic metres of gas per day and the development of Gandhar/Dahej fields presupposes the drilling of about 40 appraisal and 75 development wells and creation of surface facilities and engineering, in the development of the fields. The work at Hazira and north Tapti includes evaluation of potential of the fields through seismic surveys, interpretation of seismic data and drilling of six appraisal wells. The total cost of the work is estimated at Rs. 51 crores.

TRIPURA SEEKS CUT IN GAS PRICES

The Tripura chief minister, Mr. Sudhir Ranjan Majumder, recently reiterated the state's demand for a reduction in the price of natural gas, as in the absence of a concessional rate industrial houses and small entrepreneurs were not ready to invest in Tripura.

"If this continues for long, the huge investment ONGC has made in exploration and utilisation of natural gas in this region would go waste", Mr. Majumder said, inaugurating a two-day workshop on gas utilisation at Agartala on November 6.

In neighbouring Assam, gas was supplied to industrial sector at the rate of Rs. 500 per thousand cubic metres, while in Tripura the price was double, he said. Delivering the key note address, eminent scientists and former secretary to the govenment of India on science and technology, Dr. S. Vardarajan, said that the nation's interests should be kept in mind while giving concessions and it was better to make use of the gas by giving concession to industries at the initial stage.

Disfavouring the taking of the gas to outside the state, Dr. Vardarajan said that Tripura could save a lot of money by utilising it in the manufacture of various industrial products, which were otherwise brought from other states. Besides, Tripura's hilly terrain and its landlocked position would make transportation of gas a costly matter. The group general manager of ONGC Mr. J. Swarup, said that with more than 50 wells drilled so far in the region, the corporation could meet all the present as well as future gas needs of the state. However, in the industrial sector there has been no utilisation of this natural resource so far.

It was not within ONGC's scope to deal directly with the entrepreneurs and nor did it have any role in fixing the gas price, a function of the Gas Authority of India, he added.

DIGBOI REFINERY TO MAKE SPECIALITY PRODUCTS

The 90-year-old Digboi refinery in Assam will soon be converted into a speciality product refinery. The Indian Oil Corporation's Assam Oil Division (AOD) has planned projects to enhance production of high-value speciality products like micro-crystalline waxes, bitumen from waxy crude and, possibly, even naphthenic oil and needle coke.

According to AOD officials, three major projects which have already been approved and are under implementation are a Rs. 34 crore catalytic reforming unit for producing low-lead motor spirit, a Rs. 17 crore hydrofinishing unit and a development project at a cost of Rs. 14 crores for the production of bitumen from waxy crude.

The implementation of the Digboi refinery modernisation project estimated to cost nearly Rs. 144 crores has already started and is scheduled for completion by 1993-94. On the marketing front, Assam Oil has already enhanced its depot storage tankage capacity from around 4,000 kl in 1981-82 to about 41,000 kl at the moment. The modernisation of the country's oldest terminal at Tinsukia which is going on now is expected to provide an additional tankage of 37,000 kl. A new AOD depot with a capacity of 5850 kl is being constructed at Barapani in Meghalaya.

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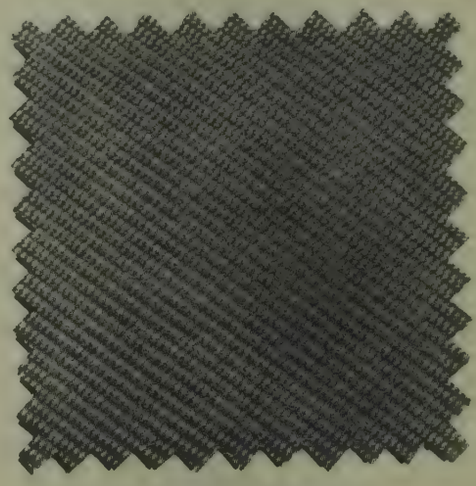

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Global tenders only for cabinet approved projects

The Oil and Natural Gas Commission (ONGC) has decided to invite global tenders for only those projects which have been approved by the cabinet. Hitherto, the tenders were invited as soon as the government approved in principle to set up a project.

The decision taken by the steering committee of ONGC recently is aimed at inviting more foreign companies bidding for the contract. Of late, the number of bidders for ONGC's major contracts has been thinning down causing concern. In fact, the trend began in 1982 when the South Korean giant, Hyundai Heavy Industries (HHI), bagged a water injection contract in the northern region. Since then HHI has been cornering most of the contracts mainly because of lack of competition.

The delay in clearance of the projects has been one of the main reasons keeping the foreign companies away from bidding for ONGC contracts. The classic case is on Panna oilfield development project which was cleared about two years back. The tenders were invited and about three companies threw in their hats for the project. However, on the eve of the last general elections, the then ruling party decided to retender the project. On retendering, only HHI participated. The price bids are yet to be opened.

Similarly, for over Rs. 2000-crore Neelam oilfield development project only two bids were received. One from HHI and another from the blacklisted Japanese consortium. In other works, HHI was the only choice, as the Japanese could not be awarded the contract for being blacklisted.

In case of Mukta oilfields, the bids received by ONGC include two from South Korea and one from the Indian company — MDL. The Korean firms are — HHI and Daewoo. The list is likely to be shortlisted before price bids are opened.

The date for opening of bids for NOP project has been extended to December 26. The last date for bidding for the contract earlier was November 28. The date has been extended ostensibly to invite more foreign companies to come forward for the contract. However, the project can be executed only after the World Bank agrees to fund it, the talks for which are currently on.

The ONGC on the other hand, is not quite pleased by the trend of the South Koreans having a field day. In the early years before 1982, the Japanese and the US companies almost exclusively won ONGC contracts. Then entered HHI for the Bombay High north field water injection platform. Since then, they have never looked back. Other Korean companies were also successful for smaller well platforms.

Two years back, when two projects were simultaneously tendered out and awarded, one went to Japan and the other to South Korea. Some suspected a cartel arrangement, although this could never be substantiated. Since then, the number of bids has further thinned.

There are Indian companies like MDL, HSL, Burn Standard and L and T who have facilities for fabrication, but none of them can deliver a process platform in time. MDL did bag a couple of major orders but were late to deliver.

For Neelam and Panna oilfields, ONGC is still in a dilemma. It has not yet decided whether it should go in for a retendering. A decision is expected soon.

The new offshore contracts have great potential to increase oil production. Panna oilfields have a peak production capability of two million tonnes of oil in a year and three million cubic metres of gas per day. The corresponding figures for Mukta are 2.7 million and two million, respectively.

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Ethanol, a petrol substitute

Ethanol, or ethyl alcohol, produced mainly from the sugarcane molasses, could be a major substitute for petrol in the country, a high-powered committee on agriculture has suggested.

The committee, headed by Mr. Bhanu Pratap Singh, says the production potential of ethanol in the country is immense in view of the fact that 1,000 kg sugarcane stalk gives a total yield of 120 kg of ethanol. Taking into account the cane productivity in India at 56 tonnes per hectare, an average of 6.72 tonnes — 8,400 litres — of ethanol could be derived per hectare of cane cultivation, the committee says.

Besides sugarcane, other crops such as sugar beet and sweet sorghum yield sugar juice and the residual biomass, could be further treated to produce ethanol. It says 112 kg of total fermentable solids of sugarcane could yield 54.3 kg of ethanol. Making a strong case of ethanol, the committee says if Brazil could run its transport system on ethanol, why should India not run its small tractors and irrigation pumps with energy produced in the farm sector itself?

Stating that the green revolution in India was short-lived, because it depended on conventional sources of energy to intensive cultivator, the committee, however, says these sources could not be discarded forthwith. Any material which is capable of being fermented by enzymes could serve as a source for ethanol production. Besides sugar-containing materials, starch-containing materials and celluosic substances could also be used in ethanol production.

Such materials are milo, corn, algae, cassava, bagasse, biomass, wood and wood waste, agricultural and forest residues, waste industrial products like sulphite liquor from paper and pulp industry, saw-dust and saw waste from saw mills, it says.

The committee says there are several farm crops capable of being used as raw materials in the fermentation process leading to ethanol production.

Stating that a variety of raw materials drawn from the vegetable world and widely grown crops are capable of fermentation into ethanol, it says starch-based feedstock include a variety of cereals and grains.

On an average, one tonne of potato yield around 100 litres of ethanol, over 45 kg of dry ice and some 90 kg dried cattlefeed, while 10 bushels of corn yield around 11 litres of ethanol, over 2 kg of dry ice and about 83 kg of dried cattlefeed. As regards cellulosic material, it says bagasse appears to be most suitable choice for use as a feedstock. Six thousand kg of bagasse is required to produce 1,000 litres of ethanol of 95 per cent strength.

The rice and wheat straw, which are available in large quantities, are also potential feedstocks for ethanol production.

As regards alcohol, the committee notes that at present the efficiency of conversion of molasses into alcohol is not at its optimum level in the country.

By efforts to improve the efficiency, the availability of alcohol could increase by about five million litres. During 1985-86, the production of alcohol was 580.10 million litres, it says.

Added to this, if khandsari molasses is also utilised for the production of alcohol a hundred million litres of additional alcohol could be made available thereby increasing the country's total capacity to 55 million litres.

The committee suggests that if the distilleries in the country are geared to operate around 85 per cent of capacity utilisation, they can produce 1,000 million litres of alcohol. It also says that the country's 35 million tonnes agricultural waste could be tapped to give another 1,600 million litres of alcohol.

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ONGC approves 131 tech. tie-ups

The Oil and Natural Gas Commission (ONGC) has approved 131 technology tie-ups between Indian and foreign companies which will provide a variety of services in different fields relating to oil exploration, production and transportation.

Fifty-one of these joint ventures are in the areas of drilling, 46 for the manufacture of oilfield equipment and chemicals and 34 in other areas.

Nearly 300 joint venture proposals were received for setting up facilities within the country for supplies to the oil sector. At present different Indian companies provide services, worth over Rs. 320 crores annually to ONGC.

The figure is expected to rise to Rs. 800 crores annually by the end of the Eighth Plan.

This will be possible because the Indian companies have taken up charter-hiring of rigs, OSVs, helicopters, diving services, marine surveys' operation and maintenance of vessels and installations, soil investigation surveys, well-logging and production testing services.

Initially, most of the these services were provided by foreign companies. No longer so. A systematic programme of indigenisation has reduced dependence on foreign sources.

Today, all major capital goods like jack-up rigs, drill ships, platforms, land rigs, well-heads and a number of oilfield chemicals are supplied from sources within the country.

Indian firms are now able to handle complex operations relating to oil exploration and production.

This has been possible because of the close and constant interaction between ONGC and various bodies like the Confederation of Engineering Industry and Basic Chemicals, Pharmaceuticals and Cosmetics Export Promotion Council.

ONGC TO COMMERCIALISE TECHNOLOGY

Oil Natural Gas Commission is planning to commercialise its technology developed at its R and D institutes. Accordingly, agreements with ten entrepreneurs have been signed for transfer of technological knowhow of patents. Also contract management procedures have been streamlined to incorporate a clause on royalty payment.

ONGC's Institute of Drilling Technology has so far developed 15 chemicals, of which five have so far been patented. Applications have been made for obtaining patents for the rest. The chemicals which have been developed by the institute include, among others, mud chemicals like ferro-chromo ligno sulphate (FCLS) and resinex, cement additives like turbulence inducers, filtration loss controlling agent and low temperature retarder, oil base mud clay, lubricants, swelling transducer and thread dope compound.

Each of these chemicals is imported presently with their availability indigenously, total foreign exchange savings is estimated to be of the order of Rs. 300 crore in the Eighth Plan. The annual requirement for five mud additives developed by the institute is estimated to be Rs. 18 crore. The demand for FCLS and resinex for the current year is estimated to be Rs. 6 crore. The technology arrangement with the various firms is carried out in three stages. In the first stage, the technology at the laboratory scale is provided free of cost. Based on successful completion, a pilot project is established in the second stage to test the applicability in the field. In the final stage, full commercial production is established but only after successful stringent quality control tests.

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Indian scientist contests findings of Nobel laureates

The findings relating to the structure of matter by three western scientists which won for them the Nobel Prize in physics jointly have been contested by an Indian scientist Prof. Rati Ram Sharma.

Dr. Sharma, Professor, and Head of the Department of Bio-Physics, Post Graduate Institute of Medical Education and Research (PGI) at Chandigarh, in an interview with PTI has contested on three counts the conclusions of the Nobel Laureates, Prof. Jerome I. Friendman and Prof. Henry W. Kendall (both Americans) and Prof. Richard E. Taylor (Canadian).

Firstly, the electron is not a structureless rigid particle but has a composition. The 'inelasticity' of scattering must be partly due to its compositeness also. Secondly, the quark structure in proton and neutron is not rigid and strong enough to retain isolated stability for revelation.

Thirdly, quarks are not the structureless ultimate building blocks of matter. Instead, the negative 'negatrino' and positive 'positrino' are the most basic elementary particles which composed even the quarks, electron and positron. These also constitute the new particles which Prof. Sharma has named 'sharmon', after him, which composes the vacuum filling real medium.

Prof. Sharma, a former President of the Indian Academy of Medical Physics and the Society of Nuclear Medicine, India, said that the three Nobel laureates claim to have found traces of quarks. They came to this conclusion when they found that the scattering of generally accepted structureless energetic electrons from protons and neutrons was 'inelastic' and that there are 'hard centres of scattering' in the targets.

Prof. Sharma also claims that the work done by the three scientists is confined to a small aspect of his (Dr. Sharma's) larger unified physical theory published as a book in January, 1990. The manuscript of the book, he says, was completed wayback in 1988.

Prof. Sharma said that this (Prof. Sharma's) theory, for the first time ever in the world, revises and unifies in itself major theories of physics like quantum theories, nuclear theories and Einstein's relatively theories. As against popular theories, it re-explains cosmic phenomenon by a theory of non-expanding universe. Prof. Sharma said that even as a student of M.Sc. in the early fifties, he was unhappy with the state of physics as a collection of unconnected topics because its major theories, though sound in themselves individually, continued to stand apart. The unified physical theory, he said, was the happy culmination of more than three decades of sustained effort.

Prof. Sharma said that he had written to international journals, 'Nuclear Physics' published from Denmark and 'Nature' published from the UK and USA as also to the Swedish Academy of Sciences, which has awarded the Nobel Prize to the three scientists, contesting their conclusions. Prof. Sharma has to his credit: proposing new physical bases of molecular specificity and recognitions, new molecular bases of disease and cure and three new sciences of inductive chemistry, xenobiology, inductoxenopathy to elucidate the science of homoeopathy for which he was awarded the prestigious Albert Schweitzer Prize in 1989.

STATUS OF MINERAL EXPLORATION CORPN. UPGRADED

The Mineral Exploration Corporation Ltd. (MECL) has been upgraded from a schedule 'C' company to schedule 'B' level. The Nagpur-based public sector MECL is one of the few organisations in the world having all facilities to conduct detailed mineral exploration and related surveys under one roof, says an official release. MECL has established over 31,100 million tonnes of categorised reserve of various minerals in 318 completed exploration projects during its 17 years of existence.

GASTGECH 1990 PROGRAMME

The final programme of Gastech 1990 being held at the Rai Congress Centre in Amsterdam from December 4 to 7, has been announced. Gastech is the world's largest conference and exhibition on natural gas, LNG and LPG.

The conference will be officially opened by Mr. A.H.P. Grotens, Managing Director, of NV Nederlandse Gasunie, who will speak on a subject he is keen to emphasise: security of supply requires longterm harmony.

The four-day conference programme covers the full industry spectrum ranging from world gas supplies in the opening session, to the end-users in the newly-introduced final session which will cover natural gas vehicles.

INDUSTRIAL ORGANICS

Industrial Organics Limited, a joint sector project, is being promoted by Punjab State Industrial Development Corporation (PSIDC) and Mr. Rajinder Gupta, promoter and managing director of Varinder Agro Chemicals.

The project is being set up to manufacture 4,500 t.p.a. of acetic acid at Barnala in Sangrur district of Punjab. The site is adjacent to the existing complex of Varinder Agro Chemcials.

The cost of the above project is estimated at Rs. 6.5 crore. To part finance this project, the company plans to enter the capital market shortly with a public issue of 14,70,000 equity shares of Rs. 10 each for cash at par.

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More pig iron for AP units

Andhra Pradesh-based foundry units have been allowed an additional 100 tonnes of pig iron supply for the current financial year. With this the total supply of pig iron through Steel Authority of India Limited (SAIL) stockyard in the state would go up to 7,900 tonnes.

However, even with the additional supplies the units would continue to remain under-stocked for want of raw materials. Against an estimated demand of between 90,000 to 1.1 lakh tonnes a meagre 7,900 tonne would be available for the units. The continuing shortage of pig iron since the last two years had already forced a bulk of the 60,000 odd around Vijayawada region to wind up the show, the foundary circles maintain.

According to it, even the remaining units were functioning well below their capacity and on raw material obtained in the parallel markets at fancy prices. Largescale black market for pig iron was flourishing in the foundry centres, the industry sources say.

According to them, pig iron produced indigenously and also those imported by the Minerals and Metals Trading Corporation (MMTC) find their way into the parallel market and are selling at anything up to two to three times the price of pig iron supplied by the stockyard.

Foundry units has been representing to the Union Government to place pig iron imports under the open general licence (OGL) so that they could at-least get the raw materials even if it meant paying a higher price. At present MMTC imports pig iron paying 45 per cent ad valorem and Rs. 315 per tonne as countervailing duty. A proposal has recently been mooted to reduce the 45 per cent duty to 20 per cent.

According to foundry industry circles, the concessional duty of 20 per cent would still be attractive for the units to import pig iron directly in case it was placed under the OGL list.

The present shortage of pig iron is likely to continue for some time to come. The Union Steel Ministry has projected the current year's shortfall in pig iron at around 2.58 lakh tonnes assuming the total production at 15.72 lakh tonnes and demand at 18.30 lakh tonnes.

"Even this demand projection is notional as many of the foundry units are not functioning now. The actual demand for pig iron in case all the units functioned at least partially would be much more than the projected figure", a foundry industry source said.

The Eighth Plan estimate of pig iron shortage was around 3.42 lakh tonnes round the terminal year of the plan.

ORE ORDER TO ROMANIA HIT

Export of two million tonnes of Indian iron ore to Romania is in jeopardy following the latter's condition that the order will be undertaken only if sufficient rupee resources are available.

The Romanians are reported to have indicated to the Indian government that iron ore can be imported if India reciprocates by buying an equivalent amount of Romanian goods. Failing this, the East European country will run up an adverse balance with India under the rupee payment arrangement.

Informed sources, however, claimed that it will be difficult for India to source such a large chunk of imports from Romania. Because of enormous political and social turmoil, economic activity has taken a blow and Romania today offers very little that India can buy.

Romania is reported to be facing trouble in the import of iron ore from Australia as well, with which it has a barter trade agreement. Normally, the Romanians place orders for coal through the Minerals and Metals Trading Corporation (MMTC) by September every year. But this year, no orders have come yet.

Importantly, the Romanian order is for poor quality coal from Redi mines. The ore has a low ferrous content (between 60 and 62 per cent) and the highest alumina content in the world at three per cent.

It is difficult to sell this ore in the international market and, therefore, the bilateral arrangement with Romania was used for exports.

Japan, which is the largest importer of India ore, has all along refused to take supplies from the Redi mines. But the latest long term agreement between the two countries envisages export of one lakh tonnes of Redi ore in the current year. Japan has agreed to import between 12 and 15 million tonnes of ore annually over the next five years. The agreement will fetch India a whopping Rs. 2,800 crores in foreign exchange.

Japan has also indicated that it would increase its purchases of Redi ore provided the alumina content is brought down below two per cent. In an effort to bring down the alumina content, the Minerals and Metals Trading Corporation (MMTC) has agreed to set up a beneficiation plant at the mine site within 12 months.

The ore will be washed in the plant and cleansed of some of the alumina content. It would then be sent to Japan for testing.

The Japanese have also insisted that the Redi ore should have a ferrous content of above 62.5 per cent before bulk import orders are placed.

But bulk Japanese orders are still one year away and till that time, unless the Romanian order fructifies, exports out of the Redi mines are likely to suffer.

INCREASING ENERGY EFFICIENCY

$ 500 m project to be launched

India is launching a $ 500 million (about Rs. 900 crores) project for increasing energy efficiency and modernisation in the industry. The World Bank is likely to provide as much as $ 250 million out of the total amount for executing the project. This is the first project of its kind being taken up by the World Bank for assistance in India.

The project would help in improving the efficiency of energy use in the country. Specifically, it has been designed to support initial development and also to strengthen the newly established energy conservation cell in the department of power and the energy management centre (EMC).

In addition, the project would aim at developing and implementing policies designed to secure improved incentives for efficient energy use and stronger institutions in the public and private sector. This is imperative for carrying out energy conservation programmes, demonstration projects in key subsectors, and a programme for R&D needs.

According to official sources, the prestigious project would consist of a technical assistance programme from the EMC and other agencies promoting industrial energy efficiency and demonstration projects in key subsectors. Further, it would help in financing the import of energy conservation devices. Similarly, the project would support additional policy adjustments which would complement these programmes.

Sources at N. Delhi said that the rationale for World Bank's involvement lies in the catalytic role it can play in helping the government to articulate an energy conservation strategy for the industry. Of equal importance is the fact that the bank is keen to mobilise support of bilateral donors which can be of great assistance in implementing the institutional support component of the strategy. A large part of any energy conservation effort must also relate to the replacement or upgradation of energy inefficient equipment.

Incidentally, it has been estimated that specific consumption of energy (energy consumption per unit of output) by the Indian industrial sector could be reduced by 25 per cent, leading to a saving of around $ 1.5 billion per year in the energy bill. Then there is the saving resulting from reduced capital investment requirements for power plans and allied infrastructure. It is against this background and the growing need for cutting down energy consumption, that the government has identified energy conservation in general, and industrial energy conservation in particular, as priority areas of activity for the Eigth Plan and beyond.

CURBS CLAMPED ON ADVANCE LICENCES

The government has clamped restrictions on advance licences involving import intensity of over 25 per cent in chemicals, engineering, electronics and hosiery sectors. Such cases will now be cleared only by the advance licensing committee at the headquarters of the chief controller of imports and exports (CCI and E).

At the same time, exporters offering higher value additon and realisation of export earnings, in a shorter period of time will be given preference in clearance of advance licences, in an effort to bring in foreign exchange quickly. Another decision taken by the commerce ministry relates to export proceeds which will now have to be realised expeditiously.

According to a press note issued by the CCI and E at N. Delhi on Nov. 8, extensions in export obligation period, revalidation of advance licences and enhancement in c.i.f. values will be granted only in deserving cases. The regional licensing authorities and advance licensing committees have been instructed to urge exporters to stick to the time period allowed for completing their exports and realising the export proceeds.

In view of the foreign exchange crunch, advance licence holders will be persuaded to source inputs from the domestic market which compare favourably with imported items in terms of quality and value, the release points out. These decisions have been taken to streamline the advance licensing procedures and to ensure that advance licence holders realise the related export earnings at a quicker pace, it is stated.

CBEC AGAINST INDEXATION OF CUSTOMS DUTIES

The Central Board of Excise and Customs (CBEC) has turned down the demand for introduction of a system of indexation of customs duties to make adjustments solely for fluctuations in the exchange rate of the rupee.

The Board has taken the stand as indexation of customs duty solely with reference to the fluctuation of exchange rate of the rupee would involve frequent changes in the customs duty rates depending on the extent of exchange fluctuation of various currencies.

In cases of any significant changes in the exchange rates, adjustments in duties are made from time-to-time.

The demand for introduction of the system of indexation was made by the industry on the ground that the high incidence of indirect taxes results in a cost push inflation. It was pointed out that though customs duties may remain unchanged or increase only marginally, the weakening of the rupee in the foreign markets results in added inflationary pressure in the economy.

Call to create awareness on patent systems

The three-day workshop on patent systems — procedures and utility —which concluded at New Delhi recently urged the government to create awareness of the patent systems among inventors in the country.

In a joint statement, the organisers and participants said the country could not remain complacent with the status of a developing country. According to Mr. Krishna Kumar, a delegate at the workshop and an inventor himself in the field of food stuffs ''though the National Research Development Corporation (NRDC), which organised the session, is a public enterprise constituted in 1953 on non-profit basis, very few know what a patent is and its related procedings are''.

This apart, lengthy formalities and arduous procedures drive an entrepreneur to seek foreign knowhow at a huge cost than make-do with indigenous technology. However, NRDC assistant development engineer Mr. Raghu Ram contested Mr. Kumar's point by saying, India was one of the few countries to have an excellent policy framework.

NRDC chief M.P. Bhatnagar informed the delegates that India was perhaps the only country to have four branches for patent office. But the information they impart to inventors is scanty, whereas the European Patent Office (EPO) in Munich has the latest information on patents. Though the corporation has set its objectives to develop and exploit indigenous knowhow, inventions, patents and processes emanating from different R&D institutions in the country, expertise is lacking to translate these into reality. For instance, an invention in chemical field has to be certified by an expert in electronic engineering field.

However, the corporation has been able to help small inventors and industrialists by providing the latest information in their respective field of invention. Plethora of patent literature is brought out the world-over from time to time on inventions of various kinds.

An inventor in a remote area need not know much of the latest developments as NRDC through its liaison powers with the EPO arranges latest information without charging any fee. The main contention regarding patent registration and commercialisation pattern is it may be true that a number of inventors are engaged in serious research activities.

However, it is not necessary that a product brought out after years of invention be commercially feasible or profitable.

WORLD ECONOMY 'IN FOR A SLUMP'

The world's economy is headed for a slump this year with little chance of full recovery, according to a report issued by the UN Industrial Development Organisation (UNIDO).

The yearly UNIDO global overview, covering 1990-91, forecasts a slump in growth from 3.3 per cent in 1989 to 3.1 per cent this year. The report, relayed by the OPEC news agency (Opecna), says 1991 will see an upturn to 3.7 per cent in growth.

Developing countries' economies are expected to grow by 3.9 per cent this year and 4.1 per cent in 1991, slightly higher than the rate in industrialised States.

UNIDO does not think the short term economic outlook in eastern Europe, unlike that in the medium term, is ''very optimistic''. Because of the disruptive effects of the far-reaching changes taking place in the region, the 1990-91 growth is likely to be close to zero.

The report points out that despite the fact that the 1980s are said to have been the Third World's lost decade, many Asian countries made substantial progress. However, for the majority of States in Africa and Latin America. ''the decade represented a continuous economic crisis, which exacted an enormous toll in terms of both progress promised and progress foregone''.

The report warns of abundant evidence of highly polluting industries moving from North to South particularly those producing hazardous substances.

''If these present patterns of structural change in world industry should continue unchecked, the environmental problems in developing countries will be likely to reach crisis proportions in the near future'', the report predicts.

INTL.MEET ON POLLUTION IN MADRAS

A four-day international seminar cum exhibition on environmental pollution is being organised in Madras from December 7 to 10. Sponsored by the Anna University and Rotary Club of Madras south, the event will see display of product and efforts by different government organisations and commercial establishments in fighting pollution.

NFL GIVES RS. 4.91-CRORE DIVIDEND TO GOVT.

The managing director of National Fertilisers Limited (NFL) on Nov. 7, presented a cheque of Rs. 4.91 crores to the minister of state for rural development, Mr. U.N. Verma, towards the dividend for 1989-90. NFL has four fertiliser plants in operation in Punjab, Haryana and Madhya Pradesh and all the four plants achieved a high level of performance during 1989-90, says a NFL press relase. With sales turnover of the company during 1989-90 at Rs. 769 crores, the company earned the highest ever gross profit of Rs. 149.71 crores. The net profit after providing for interest and depreciation was Rs. 14.17 crores, the release added.

Validity of Rep, additional licences may be extended

The validity period of replenishment (Rep) and additional licences is likely to be extended to avoid rush on opening of letters of credit in foreign exchange by actual users for the import of essential inputs for their production programmes, including exports. The validity period for imports against these licences is at present 180 days. It is likely to be increased to 240 days according to informed sources.

The commerce ministry is processing a proposal from the Federation of Indian Export Organisations (FIEO) in this regard. It has been argued by the FIEO that the extension of the time limit for these licences (which command a premium ranging from 25 to 30 per cent) be increased to 240 days so that actual users could open letters of credit according to their convenience.

Moreover, the general extension would go a long way in easing the heavy workload on offices of the chief controller of imports and exports involved in giving more time on a case-by-case basis. It may not be obligatory on the part of actual users, who purchased these licences after paying premiums, to open letters of credit immediately, thereby easing pressure on the country's precarious foreign exchange resources.

Both Rep and additional licences are currently commanding a premium as actual users can meet their requirements of raw materials and components against these licenses which have the flexibility in the import of virtually every item which is not specifically banned or listed in the restricted category. There is no doubt, that the purchase of Rep and additional licences by actual users for the manufacture of goods raises the cost of production as they have to pay a heavy premium.

But then the new policy for April, 1990 to March, 1993 represents a substantial shift towards easing the burden of discretionary licensing controls on actual users and exporters by allowing them to import a broad range of capital goods, instruments, raw materials and components against Rep and additional licences which have been earned on post-export basis.

More than two months back, the government had imposed a cut of 15 per cent in foreign exchange allocation for the import of items in the consumer goods, electronics and automobile sectors. The premium on these licences rose by at least five per cent when the government announced subsequently that imports of these items could be effected after surrending Rep or additional licences. The reported severe restrictions imposed on canalised items has also made these licences more popular. Exporters, in a number of cases, have to meet their requirements of essential inputs by purchasing these licences.

In 1989-90, the government issued Rep licences valued at about Rs. 3,500 crores, of which about 30 per cent accounted for the import of rough diamonds alone. Thus all the Rep licences were not meant for importing any input by actual users or exporters according to their choice. The value of additional licences given to export and trading houses in that year, on the other hand, was placed around Rs. 900 crores.

PLEA TO REVOKE CUSTOMS ORDER

The Chemical & Alkali Merchants Association has urged the finance secretary to withdraw a recent customs notification requiring all importers to furnish the manufacturer's invoice whenever the overseas exporter is not the actual manufacturer. The representation relates to customs notification number 44/90 (NT) of August 3, 1990. In a detailed communication, Mr. R. Natarajan, the association president, submitted the following for the ministry's consideration.

In international trade, many products are shipped by traders who buy material from various sources, and re-ship to buyers at prevailing prices. "In such cases it is but natural that the shippers would be unwilling or even unable to comply with the stipulations of the above referred notification", the letter said. It pointed out that even government purchases of items like edible oils, sugar were from traders and not producers.

In several cases, especially in Korea, Japan and China, manufacturers sell on FOB terms to general trading companies or corporations who in turn export products to overseas buyers. Such trading companies, for obvious commercial reasons, never disclose their buying prices.

Thirdly, it is only when exports are effected by an affiliate or group company of the overseas manufacturer that manufacturer's invoice can be easily obtained.

It is often observed that traders are in a position to offer more competitive terms that direct supplies from manufacturers, due to economics of bulk buying. Importers will be forced to buy at higher prices just to comply with the notification, it said.

In the absence of a mechanism to verify whether the manufacturer's certificate is genuine or not, the notification will only lead to malpractices and harassment, the association said. "We fully share the anxiety of the authorities to prevent misdeclaration of value However, we submit that this must be done by practical, foolproof producers and without causing bottlenecks to genuine importers", the communication added.

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Highlights In Chemical Technology (Part 2)

A NEW TECHNOLOGY FOR MAKING YTTRIUM-90 ON THE HORIZON

A new method to produce yttrium-90 from strontium-90 at the purity required for medical uses has been developed by Argonne National Laboratory. The process makes the radionuclide in nearly quantitative yield with virtually unmeasurable amounts of by-product ^{90}Sr and at very high chemical purity.

Development is a joint effort of Argonne's nuclear medicine group and the chemical separation group. The bench scale work on the process has been completed and scale-up is in progress. The process is expected to be in full production at Argonne by November 1990. Essentially all ^{90}Y now produced goes to the National Institute of Health for clinical applications.

Strontium-90 is a fission product of nuclear reaction has a half-life of 29 years and is a radiation hazard. Separation of ^{90}Sr from nuclear waste has been an on-going task since the early days of the nuclear industry. The chemical separation group at Argonne has been in the forefront of this separation work and has recognized that ^{90}Sr, in addition to being hazardous waste under most circumstances has some commercial potential. Strontium-90 decays to ^{90}Y which has a half-life of 64 hours, making it a valuable radionuclide for cancer therapy.

The ^{90}Y isotope can be attached to monoclonal antibodies (MABs) that can recognize antigens present on the surfaces of cancerous tumours. This therapeutic approach provides a way to target tumours to deliver the radiotherapy afforded by ^{90}Y. The effects of the radionuclide are concentrated on the tumour rather than throughout the entire host. Conventional radiotherapy is aimed at only those tumours that have been detected by diagnostic x-rays.

Chemical therapy is usually administered systematically with the chemical agents finding tumours by chance. A big problem in obtaining the desired ^{90}Y radioisotope has been to get it without also producing contaminants, including ^{90}Sr.

The new way to make ^{90}Y avoids some of the contamination problems of older technology. Very little information is available on this newly patented process. However, it is reported that the new technology depends on a solid chromatographic sorbent developed at Argonne. Radiation intensity of the ^{90}S/^{90}Y equilibrium is between 25 and 30 curies requiring that all purification of ^{90}Y be done behind appropriate shielding. There is virtually no $_{90}$S, waste produced because the radionuclide is recycled in the process.

Extractants consist only of organic compounds for which the radiolysis products are carbon dioxide and water. Strontium-30 concentration is reduced to less than 100 ppb. All other radioactive contaminant metals are reduced to levels not interfering with the bonding of ^{90}Y to the monoclonal antibody.(*C & EN*, 8/20/90, p. 8).

TECHNO-COMMERCIAL PERSPECTIVE ON SPECIALTY CHEMICALS

Specialty chemicals business is a growing sector of chemical business —particularly in developed affluent countries. Many multi-national companies have diversified in recent years into specialty chemicals for increasing their profitability.

Surfactants, according to authorities in specialty chemicals, form one of the largest product sectors in this field. As a group of chemicals, surfactants find their way into almost every manufacturing industry as well as every aspect of modern industrial society, both private and public.

According to Abe Fenster of ICI Specialty Chemical, specialty chemicals are performance chemicals. Therefore, there are almost as many ways to define the term specialty chemical as there are different product types. However, to achieve success in the specialty field, there are different criteria to those of a standard chemical manufacturer.

According to Fenster, marketing, market research and technical research must be fused into a technologically strong team, which must maintain close relationship with customers, understanding their business at least as well as they do. Perhaps most importantly, the management must be able to 'creatively manage change'. This dynamism is very essential in the specialty chemical business.

It is very important that one knows how to manage change. And changing is an essential ingredient of continuing success.

Adaptibility to change is the hallmark of a successful specialty chemicals company. And it is top management's responsibility to be able to manage that change.

Communication is an essential part of ensuring that success is achieved. If one does not properly communicate the change that is intended, clearly and properly, then all that one wants to accomplish is lost.

Interaction between people is extremely important in specialty chemicals business for both internal and external change to occur. Close customer contact and defined strategies are vital to the change process.

Employee response and motivation are also a vital factor in marketing of specialty chemicals. If an employee feels that his ideas will be listened to and he will be rewarded for his creative attempts, he will be in a much better position to respond to a customer or suggest a new market opportunity. People respond more positively to change in an encouraging accepting culture. Underpinning the service to the market, which is so vital for success in specialities, will be R&D. Without R&D and technical service there can be no successful specialty chemcials business. (*Performance Chem.* Aug./Sept.1990, p.p. 3, 4).

LIGHTNING THREAT TO CHEMICAL PLANT SAFETY

The coming of computer network in chemical process industries has augmented the problem of lightning threat. Chemical and process companies may think they have themselves covered in case of lightning strikes, but while conductors will protect their buildings, computer networks can be crippled and operators could lose control of plants.

This warning was given last August by the UK Atomic Energy Authority (UKAEA). A UKAEA spokesman warned 'As automation has taken over, computers have been designed to control very complicated processes and undertake safety functions. With the control system down, the plant could become highly unstable. Researchers at the Culham Lightning Centre, UK, one of three such centres in Europe, explained that when lightning passes through the conductor and is chanelled to earth, the building's electrical potential can be raised by several hundred thousand bolts. This lightning surge finds an easy path through computers, network cables, crippling computers, destroying network lines and even injuring operations. The UKAEA blames the setting of British Standards BS 6551 for lightning conductors, which sets specifications for protecting the building but not electrical system. One therefore, wonders whether the corresponding ISI standards takes into consideration the protection of electrical systems. (*ECN*, 8/11/90, p. 16).

A NEW COST LOWERING PATENTED TECHNOLOGY FOR THF FROM DU PONT (USA)

Du Pont has unveiled its plans to commercialize a new route to manufacture tetrahydrofuran (THF) from n-butane in Europe by 1994. The new process will produce THF at the lowest cost compared with other technologies, including the conventional acetylene/-formaldehyde based process.

The company has already completed construction in USA of two multimillion dollar pilot plants to demonstrate the newly patented technology. The new process consists of two steps: (a) the transport bed oxidation of 4-butane to maleic anhydride (MA) and (b) the hydrogen reduction of aqueous maleic acid to THF. Du Pont claims its butane oxidation process is the first application of transport bed technology for the large scale manufacture of speciality chemicals. The key to the development is a novel procedure for imparting attrition resistance to the oxidation catalyst.

The transport bed reactor achieves high selectivity to MA and the ability to recycle unreacted butane. Du Pont claims this permits MA yields of 70-75% on a molar basis, compared with 50-55% for conventional fixed on fluid bed reactors such as those employed in the competing BP Solvo and Alusuisse Lummus Crest butane oxidation processes. Direct single step reduction of aqueous maleic acid to THF at mild operating conditions eliminates several requirements of competing maleic-based routes, such as the Davy McKee and BP Solvo processes, which involves reaction with alcohol before hydrogenation to THF.

Du Pont expects the pilot plants to be operated for 6-12 months before the decision is made to go forward with a global commercial plant. THF is used primarily in the manufacture of polytetramethylene ether glycol (PTMEG) and in solvent applications. (*ECN*, 10/1/90, p. 52).

TWO MAJOR ADVANCES IN AMMONIA TECHNOLOGY UNVEILED BY KELLOGG (USA)

The US-based engineering company M.W. Kellogg has recently unveiled two major advances in its ammonia process technology.

One advance is the commercialization of the Kellogg Reforming Exchanger System (KRES), which allows complete elimination of the fired primary reformer from the ammonia plant process design. In KRES, the reforming exchanger and secondary auto-thermal unit are fed in parallel and the combined effluent from these units passed back to provide reaction heat to the reforming exchanger and preheat for the parallel feedstreams.

KRES is reported to be environmentally attractive because without a primary reformer, nitrogen oxide emissions are considerably reduced. It is easily installed in new or existing plants, saving in capital costs. The second advance is a new ammonia synthesis catalyst which is the main feature of the Kellogg Advanced Ammonia Process (KAAP) — a joint technology development with British Petroleum.

The KAAP catalyst is claimed to have a higher activity than other ammonia catalysts and a relatively small volume of catalyst is needed.

When retrofitted to existing processes, the catalyst can increase ammonia yields 20 to 22 mole % without increasing capital cost. Energy savings are also possible. The catalyst is manufactured and supplied by Engelhard Industries. (*ECN*, 10/3/90, p. 52).

A CLEAN TECHNOLOGY UNIT PIONEERED IN UK TO BOOST INTEREST IN ENVIRONMENTALLY FRIENDLY PROCESSES

Two leading UK research bodies have set up a joint Clean Technology Unit to boost interest in new processes and equipment that does not harm the environment. The Science & Engineering Research Council and the Agricultural Food Research Council have appointed Dr. Nicholas Lawrence of SERC to head the unit. Projects already in the pipeline include removal of heavy metals derived pyrolytic oils and the use of lignite in a novel separation process to remove organic pollutions from factory effluent. (*ECN*, 10/3/90, p. 52).

GLASS CLOTH FOR PRINTED CIRCUITS DEVELOPED WITH LOW DIELECTRIC CONSTANT

Unitika Ltd. of Japan has developed glass cloth for printed circuit boards using silica rich glass fibre (trade name: Silica Fiber) developed by Akzo NV, Netherlands. Printed circuit boards prepared using the new glass cloth have a low dielectric constant of roughly 4 x 10^2 CPS. Those having a low dielectric constant are capable of speeding up handling of electric signals and facilitate high-density wiring. There is a growing demand for printed circuit boards with high-wiring density along with increased commercialization of small sized OA equipment and video cameras. The company is also considering promoting application of the new product to printed circuit boards for high-frequency applied electronics equipment (receivers for direct broadcasting and portable telephones, etc.). Unitika has hitherto produced glass cloth for similar purposes from glass fibre called 'E-Glass' and has captured 20% of the domestic Japanese market. E glass consists of silica (55%), alumina (16%) and other ingredients.

The dielectric constant of printed circuit boards produced from E glass-based glass cloth stands at 6 x 10^2 Cps.

E glass is transformed into glass cloth using an air jet loom. A special loom called a rapier loom is employed for weaving silica fiber since the product is somewhat inferior to E glass in flexibility. (*Japan Chem Wk.*, 3/8/90, pp.3,4).

HIGH-DUCTILITY INTERMETALLIC COMPOUND PIONEERED BY NIPPON STAINLESS STEEL (JAPAN)

Nippon Stainless Steel Co. of Japan is collaboration with the Institute of Materials Research, Tohoku University — has developed Li_2 -type intermetallic compound having high-level ductility at ordinary temperature. Intermetallic compound becomes stronger as the temperature rises. Ordinary ones are, however, fragile and lack workability at ordinary temperature. The new product is free from such shortcomings and can be subjected to precision molding and pressing processes. It will be employed as high-strength, heat resistant structural material for automobiles, aircraft and space equipments.

The company has produced the intermetallic compound — Ni_4 (Si, Ti) — by adding titanium to Ni_3Si. The product has a force centred cubic structure in which nickel atoms are located in the centre of each face and silicon atoms in the corners of the cube. Titanium atoms serve to reinforce the grain boundaries of the crystalline structure. Well known intermetallic compounds are niobium-tin alloy (component ratio 1:3) used as superconductive material and lanthanum nickel usable as hydrogen storing alloy. They have yet to be practically used as structural material. The company plans to find outlets for the new product in the manufacture of heat-resistant parts for automotive-use rotors and gas turbines. (*Japan Chem Wk.*, 5/31/90, p.3).

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Food & Pharmaceutical Technology In Perspective (Part 2)

FRAMINGHAM HEART STUDY CONFIRMS PROTECTIVE ROLE OF HDL

A simple cholesterol test may not be able to predict the risk of heart disease as accurately as was once thought. A major study has found that the levels of the so-called 'good' fraction of blood cholesterol, high-density lipoprotein (HDL), in the blood are more important than previously realised. Until now researchers believed that the level of total cholesterol was what mattered and the HDL levels were only marginally important.

The new data comes from Framingham Heart Study in USA, a long term survey of a sample of men and women in a town in Massachusetts. The effect was most striking in women. Those with the lowest level of HDL were 5-times as likely to die from heart disease than those with the highest level. (*New Sc.*, 8/11/90, p. 23).

THE QUEST FOR LOW-CALORIE FAT SUBSTITUTES CONTINUES AT A FURIOUS PACE IN AFFLUENT COUNTRIES

Food manufacturers in affluent countries have tremendous new opportunities in the 1990s to satisfy consumer demands for low-calorie foods, particularly fat substitutes. The greatest level of R&D in fat substitutes has been into new materials, particularly in affluent USA. This has given rise to wholly new compositions of matter, whose intrinsic functions mimic those of fats and oils. The product receiving the most extensive publicity in this area is undoubtedly sucrose polyester, or olestra, a novel fat substitute developed for nearly 20 years by Procter & Gamble.

Many newer candidate fat subsitutes are at various stages in their R&D. Nabisco Brands has patented carboxy or carboxylate esters as fat mimetics. Unlike Olestra, these carboxyl/carboxylates esters are partially metabolized and it is claimed that the problems associated with non-metabolisable fat substitutes will therefore be reduced.

Another recently patented product from Atlantic Richfield in USA is an esterified propoxylated glycerol (EPG). The company claims that non-caloric fat substitutes with physical properties ranging from liquid oils to fat and greases can result from their process and that all products have good taste and texture. EPG is resistant to intestinal absorption and not hydrolysed to any significant extent in the digestive tract.

Over the years a large number of other fat substitutes have been patented at one time or another. These include alkyl glyceryl ethers, patented in the early 1980s by Swift & Co., jojoba oil for which Lever Bros were granted a US patent in 1982, and polycarboxylic esters, with patents issued to CPC International and Frito-Lay. (*Performance Chem*, Aug/Sept. 1990, pp. 40-41)

DIETARY FIBRE ADDITIVES IN PROCESSED FOOD POISED FOR GROWTH WORLDWIDE

In affluent countries, increasing health consciousness had led to greater awareness towards increasing consumption of dietary fibres. This trend has also appeared in affluent urban regions in developing countries. Recommendation made by various public health organisations all suggest that the consumption of dietary fibre should be increased. In USA, the market is growing rapidly. The sales value of dietary fibre additives in 1987 in USA was estimated at $253 million by Arthur D Little Co. This value is expected to grow to $455 million by 1992. Currently, there are more than 100 firms worldwide supplying dietary fibres and gums to the food and pharmaceutical industries, more than half of these are in the USA. Firms include cereals and grain processors, wood pulp and paper companies, food ingredient brokers and importers, chemical companies, fruit and vegetable processors and brewers. Agricultural commodities, at one time restricted to animal feeds have become valuable as source of dietary fibre as the market for these additives has grown.

However, no one fibre is successful in all foods. Therefore, firms offering a broad range of fibres with well-defined functions and well-documented nutritional benefits are more likely to succeed. However, the cost of generating the data to support nutritional claims may mean that some will fall by the wayside. The number of suppliers will shrink to those who know the functional applications of each fibre intimately and can identify the food products in which that fibre will work well.

These suppliers will establish their products clearly in that category and will provide an appropriate technical service. For example some companies are developing modified dietary fibres using a bleaching process. Bleaching can produce white, low flavour products with a high dietary fibre content, including low-calorie white bread; it has enormous potential for new applications in foods where existing fibre sources are technically inadequate. Other market opportunities will be developed based on other sources of dietary fibre. The cholesterol lowering properties claimed for oat bran, psyllium and guar gum have prompted companies to examine other plant fibre sources. This property has also raised export market for psyllium and guar gum based bulk laxative

formulations have appeared in the pharmaceutical market in several countries.

A NEW ENZYMATIC TECHNOLOGY SELECTS CHIRAL AMINES FOR FOOD AND PHARMACEUTICAL APPLICATIONS

A new enzymatic technology can select desired chiral forms of a wide range of amines for pharmaceutical, foods and agricultural applications. The US-based biotech company Celgene has been recently awarded patent for its technology which manipulates the internal chemistry of certain bacteria to produce enzymes that can synthesize the desired chiral isomer or separate the undesired isomer from a chemical.

Celgene estimates that the technology can be used to purify around 500 drug compounds in development. This could lead to lower dosage levels because of increased efficacy and reduced side-effects.

The technology is now being developed on a commercial scale. Celgene reports "The field of chirality is receiving intense interest from pharmaceutical firms and regulatory agencies. Current chemical methods of separating isomers are expensive and inefficient". In agriculture it can cut applications of crop chemicals by half. (*ECN*, 10/3/90, p. 52).

A NOVEL COLOUR-CHANGING PIGMENT FOR COSMETICS DEVELOPED BY SHISEIDO (JAPAN)

Shiseido, Japan's leading cosmetics producer has succeeded in making inorganic photochromic pigment capable of changing colour on exposure to light for use in cosmetics. This is a new landmark in cosmetic science, since so far no such pigment has been used in cosmetic formulations. The new pigment is titanium dioxide powder mixed with a special proprietary metallic oxide having a photosensitive property. It changes colour depending on the amount of light applied there to and returns to the original state in a dark phase. The company intends to use this new pigment for make-up and for other novel cosmetic formulations.

Photochromic compounds have so far been applied to eyeglasses and apparel which turn dark when exposed to light and returns to their normal state with the removal of the light source. Conventional compounds have a problem with regard to light fastness, safety and stability and are not suitable for cosmetics. The new pigment has a high level of light fastness and is safe with excellent covering power and adhesion power on the skin. In addition, it is pink in colour and so very suitable for application to cosmetic formulations. (*Japan Chem Wek.*, 3/8/90, p. 2).

JAPAN PLANS STRINGENT STANDARDS FOR FUNCTIONAL FOODS

The Ministry of Health & Welfare of Japan has inaugurated Functional Food Research Committee comprising experts from various related fields with reference to functional foods. The Committee is scheduled to check data on functional food, which the Functional Food Forum will submit to the Ministry early in 1991. The Ministry plans to establish standards for functional foods based on the data collected. The Forum was formed in September 1989 by related industrial groups and its membership has expanded from 101 at the start to 251 firms. It consists of 11 working groups, which cover:

(i) dietary fibre
(ii) Oligosaccharides
(iii) Sugar alcohols
(iv) Peptides and proteins
(v) Polyhydric unsaturated fatty acids
(vi) glycosides, isoprenoid and vitamins
(vii) alcohols (alcohols & phenols)
(viii) choline
(ix) lactic acid bacteria
(x) minerals and
(xi) others, respectively.

Functional food is expected to provide new business opportunities and has become of growing interest to the drug and other industries as well as the food industry. As a matter of fact, several new products have been commercialized in recent months. (*Japan Chem Wk.*,3/8/90, p. 4).

A STRONG TREND TOWARDS HERBAL MEDICINES IN EUROPEAN COMMUNITY

A multiclient study of the E.C. market for herbal medicines from 1990 to 1994 is being compiled by the UK consultancy company, McAlpine, Thorpe & Warrier, (MTW) to have a comprehensive review of current and future developments in the herbal medical field throughout the European Community (EC). The herbal medical industry has experienced rapid growth in many regions including the EC, but it is generally acknowledged that there is a lack of market information according to MTW. The market is very fragmented and the advent of the single European market will prompt companies to investigate the advantages of operating on a pan European basis. Economics of standardization and of scale are expected to take on increasing importance, and the possibilities of acquisition, joint ventures and franchising are of particular relevance.

This situation raises good prospects for manufacturers and exporters of herbal drugs in India. Even Ayurvedic and Unani drugs could find a market in EC in future if proper approach is made for export to EC countries.

The new study, which covers prescription and OTC products, categorised by therapeutic activities, looks at the industry's prospects within the EC for the next 5 years. It aims to identify major products and trends in new products, and to estimates sizes and growth rates for different product sectors. It

will also estimate potential herbal medicine use in each country. The report will identify major suppliers, estimate their market shares and carry out competitor analysis. On the regulatory front, it will forecast likely developments and analyse licensing policies and legislation adopted by individual countries and by the EC.

For further information contact McAlpine, Thorpe & Warrier, 50 Pennyovern Rd, London SW595X, UK.

THE WORLD'S FIRST OPIOID ANALGESIC APPROVED BY FDA IN USA

Janssen Inc. (USA) has comfirmed recently that the recent US approval by FDA of TTS Fentanyl, Alza/Janssen's transdermal formulation of the opioid analgesic was the first approved worldwide.

The transdermal TTS Fentanyl is used mainly for the management of chronic pain. It delivers Fentanyl at a controlled rate for 72 hours. Fentanyl, which until now has mainly been administered intravenously during anesthesia, was originally developed by Janssen, under its trade name Sublimaze. The transdermal version was developed by Alza on behalf of Alza TTS Research Partners Ltd.

Transdermal Fentanyl is the first product based as Alza's transdermal technology to be registered in USA and the first transdermal system for the management of chronic pain in patients requiring opioid analgesia, and its principle application will be in cancer pain. (*Scrip.*, 1540, Aug. 15th 1990, p. 22).

A NOVEL DRUG DELIVERY SYSTEM FOR PROTEINS DEVELOPED BY CORTECS LTD. (UK)

A UK-based pharmaceutical company has recently developed a novel drug delivery system. This new technique overcomes the problem with oral dosing of large proteins, namely that they are digested by enzymes in the stomach, and only poorly absorbed. Cortecs' system protects the therapeutic protein from digestive enzymes by coating it in fatty molecules, which in addition enables the protein to be absorbed in the small intestine by the lymphatic system, increasing bioavailabilty.

Hoffmann La Roche is greatly impressed by the above drug delivery system and has signed an agreement with Cortecs, for developing an oral interferon formulation. Cortecs also hopes to develop oral formulations for erythropoeitin (EPO), insulin, calcitonin and human growth hormone (HGH).

In respect of oral EPO, Cortecs announced earlier this year it had successfully tested the drug, collaborating with an unnamed Japanese pharmaceutical company. EPO stimulates the production of red blood cells and is used to treat anaemia associated with chronic renal failure.

Results from trials of the oral EPO formulation were encouraging, since a high degree of bioavailability was found when administered to healthy subjects. The oral formulation gave blood levels of EPO similar to that achieved by injection at levels up to twice the normal injected dose. (*ECN.*, 10/3/90, p. 49).

CAUSATIVE GENE FOR OSTEOARTHRITIS IDENTIFIED

A mutant gene that causes osteoarthritis, the most common form of arthritis has been found by biochemists at Thomas Jefferson University (Phila., USA) and rheumatologist Roland W Moskowitz of Case Western Reserve University. Researchers, now know that a gene can cause osteoarthritis (the degenerative bone joint disease).

In the study, genetic material was examined from 19 members of family — representing 3 generations — nine of whom had a form of osteoarthritis, called primary generalised osteoarthritis. When the gene for type-II collagen protein from the nine was isolated, cloned and seqenced, all coding sequenced, were found to be normal, except for a single base mutation.

The mutation converts an arginine residue to a cysteine, an amino acid not normally found in type-II collagen. The collagen gene was suspect because previous work by researchers (at Thomas Jefferson Univ.) had shown that it is co-inherited, and thus associated in some way with primary generalized osteoarthritis.

This amino acid mutation was present in all affected members of the family but not in unaffected ones nor in 57 unrelated individuals. This suggest that some cases of primary generalized osteoarthritis are caused by the mutation, although the researchers believe other mutations or multiple factors could sometimes be involved. Some types of osteoarthritis are known to arise from non genetic causes, such as joint injuries and bone defects.

A chemical interpretation of the findings is that the arginine-to-cysteine mutation causes deleterious structural changes in collagen. Type-II collagen molecules are composed of three chains that coil around each other to form triple helices. The helices then assemble further into tight bundles called fibrilla. The genetic flaw could possibly be disrupting both the triple-II collagen and the ability of fibrills to form stable support structure.

This discovery could eventually lead to better diagnosis of and therapies for osteoarthritis. Genetic tests to identify carriers of the mutation could be developed in future. In addition, the researchers believe it may be possible to develop drugs that manipulate the gene or block its action. (*Proc Natel Acad. Sci.*, 87, 6545, (1990)).

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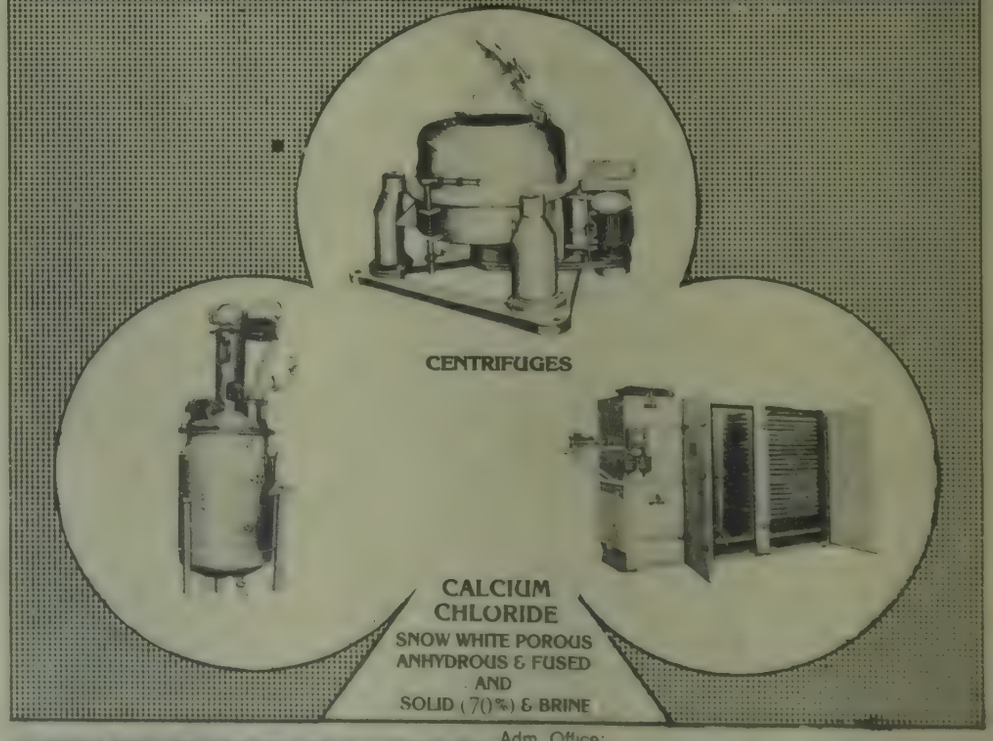

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PRODUCTION MANAGEMENT

Part-I — Introduction

N.R. PAI

What is production?

Production involves transformation of the available and appropriate raw material/s into the finished goods of utility. It is in fact creation of goods of utility. When used in a broader sense the term can be extended to cover creation of useful services also, e.g. refrigeration, airconditioning etc. Airconditioning for example is nothing but production of cool atmosphere.

Examples of production

Furniture making

Wooden planks are available from wood cutting and wood working industries. They can be cut to the required sizes, shapes and designs and then assembled to form a chair or a table or a cupboard.

Manufacture of an automobile, an aircraft or a railway locomotive

Here different component parts are made first and then assembled to get the final useful product.

Getting metal from its ore is one more example.

From the above examples, one notices that the raw material source can be either nature or another industry. Again the transformation of raw material/s into finished goods generally involve several successive operations to be carried out by men and/or by machines. Thus to get metal from its ore, the latter has to be dressed and treated chemically in a number of steps or stages. Each such step is called ''unit operation'' and the process of conversion of which these ''unit operations'' form parts is called ''unit process''.

What production achieves?

But what do we really achieve in this process of production. It is worth noting that during this production, transformation occurs whereby utility value of raw material/s gets stepped up significantly. Wooden planks for example do not have much of a utility value as such. But once they are assembled into a table, a chair or a cupboard, they can be put to use, they can serve the exact needs of the customer, their utility value being stepped up substantially. It is for this added or increased value that the customer pays. Now, during this transformation, along with value stepping up, resource utilisation also occurs. This resource utilisation incurs expenditure i.e. to create value we incur costs — costs of resources used. Profit as can be easily seen is the difference between the price paid by the customer and costs incurred after resource expenditure.

Now, what is management?

We have seen that the production generally involves several successive operations to transform raw material/s into finished goods. To carry out these operations effectively you require:

1. Place of work, first of all, where one can carry out production processes smoothly.
2. Regular, unhindered raw material supply, on which crucially depends, the keeping up of production schedule.
3. Well chosen machines to carry out the needed production operations, and above all,
4. Man power or human element (trained or to be trained) to run these machines.

Further, the principal activities of a manufacturing industry namely ''production'' and ''marketing'' have to be supported by or supplemented with several other ancillary or secondary activities for their smooth functioning.

The secondary activities include for instance:

1. Raw material procurement from right supplier/s.
2. Finished goods despatch to customers (in time, in proper packaging, in right amount and of a standard quality).
3. Appointments of suitable persons at different ranks, cadres and levels; training them up if need be.
4. Maintaining records of: i) raw materials purchased, utilised and their stocks in hand, ii) machines, their spares, accessories — purchased, used and stored, iii) tools and equipment, iv) finished goods — produced, despatched and stocked, v) personnel records — regarding date of joining of employees, their salaries, increment dates, confidential reports etc.

Now, all these organisational activities (main as well as ancillary) are to be carried out with the help of human element, which in turn has to be: a) trained (if need be), b) directed, c) supervised, d) coordinated, e) followed up and f) corrected from time to time and this is exactly where management steps in.

To put it in nutshell management includes three major aspects of an organisational functions. These are 1) to plan, 2) to execute and 3) to review. The basic aim of any management is the minimum utilisation of resources at the disposal of an organisation. The least expenditure of resources is directly linked to the profit maximisation. Let us go a little deeper in this term ''management''. What does this word

"management", "executive" or say "manager" exactly convey?

In fact the word "management" or "manager" makes different meaning to the persons coming from different categories or from different walks of life, which often includes their social placement or economic status. Very often "managers" are looked up as persons belonging to a privileged class. They are considered as an "overcared for" class of persons, who rest in their cushy chairs, in their airconditioned cabins, simply issue orders and sign some papers for which they are paid fat salaries; while others work hard with their instruments, tools or at their machines to earn their bread.

But then is this true? Can an organisation dispense with its managerial cadre? Can any person from any other cadre if placed in chief executives' chair can lead the company to the same achievement and identical success? If not, then what are the qualities which distinguish them from others? What are the qualities which go to make an executive or a manager? High ranking managers and executives holding top most positions must have administrative abilities and leadership qualities. They must be able to plan, organise, execute, supervise, follow up and review the tasks assigned to them. However, so far as middle managerial cadre is concerned it is enough if they show a good skill of getting the work done from their subordinates. The question therefore arises as to what are the leadership qualities and wherein lies the administrative ability?

Leadership qualities

A leader should be capable of influencing and modifying the approach of his subordinates towards their tasks in such a way that they perform their duties willingly and wholeheartedly putting in their best efforts to get the work done to its utmost efficiency. Note that, it is easy to get personnel at work but it is difficult to get their "will" at work. Again it is easy to carry out the work assigned to yours, but it is difficult to create profit-fetching work from hundreds or thousands of persons working under you. It is the leader who has to do this. Work force represents energy and the job of a leader is to channelise this available energy in the most profitable manner.

Further, the leader should be intelligent and should have perfect and quick grasp of the situation at hand. A good analysing mind would help him to arrive at correct decision. He should be well-versed in communication and should be unambiguous in expressing himself which would assure a followership of excellent order from his subordinates. Again at the time of crisis a leader is expected to rise to the occasion. He should not get panic-stricken and should not throw responsibilities on his subordinates, blaming them and keeping himself away from the scene to save his own skin. This happens especially during workers unrest or during departmental inquiries. In case a leader leaves his subordinates in the lurk at the time of difficulties and crisis, no wonder then, if his subordinates lose faith in him. They would trust him no more and would no longer look upon him as a true leader and their genuine well-wisher. Executive should therefore be bold and courageous. More leadership qualities will be considered later under "the functional aspects of management".

Administrative abilities

In the first place administration involves ascertaining goals of an organisation and policies determined to achieve them. Next comes in the line: preparation of programmes and procedures to work them out efficiently. Administration further covers areas of staffing the enterprise with right type of personnel, arranging for and putting together all other needed resources and executing the chalked out procedures by initiating and monitoring actions of the subordinates to attain the predetermined goals. It thus brings into picture every day programming and directing of company's activities.

Next comes in line is the "review" aspect of an administration. The results achieved should be reviewed in the light of planned programme. This is followed by applying correction to avoid future deviation from the chalked out path. At times, review helps administration to improve its future planning also. To an extent, these two qualities of leadership and administration may appear to overshadow each other at certain points, at times. Leadership qualities and administrative abilities are therefore the two most distinguishing features with which a top executive must be equipped with.

There is one more point that should be brought to light. Very often it is argued that an executive is born and not made. However, without entering into further discussion on this controversial point and even taking for granted this statement, it cannot be ignored that training is needed to shape and sharpen these inborn qualities in an individual, so that his natural talents, skills and abilities are aptly and effectively channelised in the right direction.

The chief executive therefore must know very clearly how to deal with all the factors which are important to run an enterprise. These can be summed up as: money, materials, machines, procedures, men (motivation), finished goods, and markets. The job of the chief executive therefore boils down to setting up an organisation, putting it in action and by levering proper controls, maintain its smooth function to attain the desired objectives.

The functional aspects of management

These aspects can be subdivided into two main heads namely: A. Leadership aspects and B. Administrative aspects.

Leadership aspects

Authority delegation

It amounts to entrusting authority to subordinates. Here the deputy is authorised to take action on behalf of his superior; coupled with it he also has to take corresponding responsibility for the results. The idea is to free the top boss from routine and details of the work, so that he can devote most of his time for more important management tasks. Delegation therefore ranks first and should precede all other aspects of leadership functions.

Motivation

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Behavioural science approach

The behavioural scientist do not believe in employing threat as an instrument of motivation. Threat can be in the form of status reduction, withholding promotions and worst, the fear of being sacked. Such threats were earlier used by some managers to keep subordinates under constant pressure and to extract maximum work from them. But soon it was realisd that threat in no way can arouse willing performance. It often results in unwilling performance and unwilling performance is minimum performance. As a consequence, therefore fear or threat is generally written off as an effective tool of motivation by a successful executive.

To elaborate on this point of "human performance and motivation" in the light of the present situation it can be said that to-day's manager is working under much changed circumstances as compared to a manager half a century back. To-day the situation is totally different. Workers cannot be and should not be looked upon as a mere tool or mere instrument to get the work done. Worker or any employee for that matter is human first and producer afterwards. This fact has universal acceptance in the present world, and it is right also. To-day a worker can become a worker-director, he can participate in management's decision making process too. Manager of today must have sufficient awareness of this fact if he wants to be a success. Again it is manager's skill to handle his subordinates which profoundly influences profit or loss and even survival or extinction of a running organisation. Big industrial houses in USA and other advanced countries are therefore investing significantly to develop human resource.

Recent approach to control

Coming to the basic point: When is an individual tempted to work? The simplest answer is: When the work affects his future or in other words when the work "matters" to him. The job of the manager therefore boils down to making his work "matter" to him. This in turn brings in "control" or "monitoring" aspect by way of rewards and punitive actions. But by very nature any individual for that matter is allergic to "control" or "pressurising". He is then tempted to respond negatively. On the other hand he responds well to positive aspects of treatment which keeps up his "dignity" and "freedom". By very nature an individual loves "liberty" and hates "restrictions". Positive form of control upholds these latter points in controlling subordinates, since they go unnoticed and yet achieve desired goals. To-day, the behavioural scientists believe that managers should first try the positive forms of control, failing which he may resort to negative forms. Negative forms involve punitive actions and arouse lot of opposition from an individual. Positive forms of control on the other hand go unnoticed and still they influence behaviour of every individual and help in attaining aimed objectives. They rarely or rather never meet with an opposition and they pay rich dividends to the "controller" and the "controlee".

In the positive control, for any mistake (not negligence), the individual should be shown how much it costs the company and how it would affect adversely the future of the company as well as that of its employees. He should be corrected and should be given a fair trial, a fair chance to improve his future performance, without hurting his ego. Sometimes it happens that an employee may not attain total success in his work but has put in his best efforts forward. In such cases positive control says that he should be patted for whatever he has achieved and then encouraged more to enhance his future performance to attain total success.

On the contrary, if a subordinate is pulled up for his every mistake without giving him any chance to improve, his negative tendencies are likely to come up. He may feel insecure at his current working position. He may feel that he may be replaced. He then works under pressure — pressure of insecure future. No wonder then if in that case half of his energy gets diverted in looking for an alternative job. It means he becomes less productive at the job in hand. He may even

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Recent approach to control

Coming to the basic point: When is an individual tempted to work? The simplest answer is: When the work affects his future or in other words when the work "matters" to him. The job of the manager therefore boils down to making his work "matter" to him. This in turn brings in "control" or "monitoring" aspect by way of rewards and punitive actions. But by very nature any individual for that matter is allergic to "control" or "pressurising". He is then tempted to respond negatively. On the other hand he responds well to positive aspects of treatment which keeps up his "dignity" and "freedom". By very nature an individual loves "liberty" and hates "restrictions". Positive form of control upholds these latter points in controlling subordinates, since they go unnoticed and yet achieve desired goals. To-day, the behavioural scientists believe that managers should first try the positive forms of control, failing which he may resort to negative forms. Negative forms involve punitive actions and arouse lot of opposition from an individual. Positive forms of control on the other hand go unnoticed and still they influence behaviour of every individual and help in attaining aimed objectives. They rarely or rather never meet with an opposition and they pay rich dividends to the "controller" and the "controlee".

In the positive control, for any mistake (not negligence), the individual should be shown how much it costs the company and how it would affect adversely the future of the company as well as that of its employees. He should be corrected and should be given a fair trial, a fair chance to improve his future performance, without hurting his ego. Sometimes it happens that an employee may not attain total success in his work but has put in his best efforts forward. In such cases positive control says that he should be patted for whatever he has achieved and then encouraged more to enhance his future performance to attain total success.

On the contrary, if a subordinate is pulled up for his every mistake without giving him any chance to improve, his negative tendencies are likely to come up. He may feel insecure at his current working position. He may feel that he may be replaced. He then works under pressure — pressure of insecure future. No wonder then if in that case half of his energy gets diverted in looking for an alternative job. It means he becomes less productive at the job in hand. He may even

avoid work by remaining absent just in protest against punitive treatment he has received. This is a loss to the company as also to the leader and to the invidual too. The best course therefore is to try out "positive control" approach first failing which "negative control" may be tried when nothing else works.

Subordinate control linked to the recruitment factor

There is one more aspect of successful control which is based on the appropriate selection of subordinates while recruiting them. It is said that broadly speaking there are two types of individuals: 1. Persons who love discipline by their very nature. They are self-restrained and self controlled. Such individuals respond well to positive control. 2. Persons who by nature lack discipline or rather believe in flouting it. They therefore require a stronger form of control — perhaps a negative one.

It goes without saying then that the success of an organisation largely depends upon selecting first type of individuals while recruiting who easily respond to positive form of control.

(to be continued)

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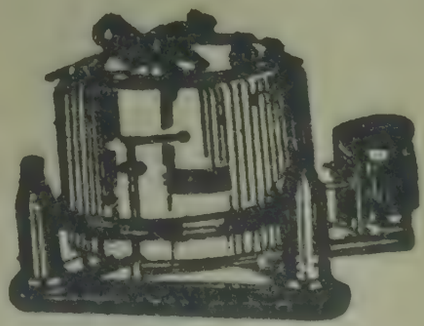

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Science Briefs

TECHNOLOGY FOR PROCESSING DEMENTHOLISED OIL

The Central Institute for Medicinal and Aromatic Plants (CIMAP), Lucknow, has developed a technology for fractionating dementholised oil into individual components with good market value.

Dementholised oil (DMO) is formed as a low-value by product when the natural aromatic oil of the herb Mentha arvensis is chilled at low temperatures.

This oil cannot be used in flavouring and perfumery industries because it contains monoterpenes and menthone which give it a poor odour. Monoterpenes form 10-12 per cent of the DMO and menthone 25-30 per cent. Its other constituents are 5-8 per cent methyl acetate and 35-45 per cent menthol.

The CIMAP process for fractionating the DMO in a high vacuum column gives three portions: liquid menthol containing minimum 90 per cent menthol, menthone, and a mixture of terpenes.

The liquid menthol fraction has a sweet peppermint flavour which has been found to be very useful for flavouring toothpastes and confectionery. Menthone with 90 per cent purity serves as a useful aromatic chemical for the perfumery industry and has a good export market. Menthaterpenes are also of use in the chemical industry and have a ready export market. The fractionation process thus helps yield not only improved menthol, but also other components that can earn foreign exchange.

P.T.I. Science Service, October 1-15, 1990, p. 1.

WATER/STEAM CHEMISTRY DIAGNOSTIC SYSTEM

The Bharat Heavy Electricals Limited (BHEL) has developed a state-of-the-art computer-controlled system that diagnoses the water/steam chemistry in thermal power plants.

Proper water/steam chemistry, determined by parameters like pH, conductivity, silica, hardness and iron, is essential for ensuring trouble-free operation of the boiler.

The BHEL system monitors the pH, conductivity and silica continuously on-line, while hardness and iron content are monitored off-line by sampling procedures. The system comprises three sub-systems: data acquisition system, master computer and slave computer.

The data acquisition system is microprocessor-based and received all 4-20 milli amperes analog input signals from the various analysers. The data is transmitted to the master computer whenever required.

In the master computer, all the values both on-line and off-line (fed by the operator through the slave computer) are compared with pre-set high and low limits, for safe operation of the boiler.

On the basis of these comparisons, the system advises on the corrective actions to be taken. Whenever any value re-attains the normal level, both the time of the normal value and the previous time when the value was abnormal are indicated. With the help of the slave computer, the data in the master computer can be accessed and modified without disturbing the master computer.

P.T.I. Science Service, October 1-15, 1990, p. 2.

NEW INSECTICIDE FROM TOBACCO WASTES

Tobacco wastes have been found to be a source of a new, highly-effective and safe insecticide — nicotine sulphate.

The finding was reported by scientists at the Central Tobacco Research Institute in Rajahmundry in Andhra Pradesh. Nicotine sulphate has been found to be very effective against a wide range of insect pests which have developed resistance to chemical insecticides like organochlorines, organophosphates and carbamates.

It has been found to be specially effective in controlling the gram pod borer (Heliothia armigera), both at the egg and larval stages, the whitefly (Bemisia tabaci), the semilooper caterpillar (Spodeptera litura) and the polyphagous pest. The product poses no hazards to either human health or the environment.

Five ml. of nicotine sulphate mixed with a litre of water kills the insect pests within three to seven days.

P.T.I. Science Service, October 1-15, 1990, p. 3.

NOVEL DISTEMPER

Industrial chemists in Gujarat have prepared a novel distemper based on emulsions of aromatic hydrocarbon resin (AHR), which they report is both cost-effective and superior to oil-based distempers. The aromatic hydrocarbon resin (AHR) was plasticised with resinous plasticisers in various proportions to replace the conventional drying oils used in distemper formulations.

The new distemper was formed during trials by scientists at the VP & RPTP Science College, Gujarat, aimed at overcoming some of the limitations of oil-bound distempers. These disadvantages are several. The films are prone to alkaline attack, making them unsatisfactory for use on fresh plastered walls. The oil-bound distempers are water-permeable to a certain degree, not very hard and have poor resistance to abrasion. They also dry over a long period of time and show a marked tendency to yellowing. Scientists from the department of industrial chemistry of VP & RPTP Science College prepared

three distempers from stable emulsion of aromatic hydrocarbon resin obtained from the Indian Petrochemical Corporation Limited, which was plasticised with a resinous plasticiser (long oil soyabean alkyd) in varying proportions. Tests on the distempers showed that as the resin:plasticiser ratio is increased, the levelling property, flexibility and adhesion are improved.

Unplasticised resin is very brittle and adheres very poorly. However, increasing the plasticiser amount beyond a point decreases the distemper's resistance to weathering, discolouration and alkali resistance. Therefore, a critical resin:plasticiser ratio has to be employed. The new distemper was found to be vastly superior to oil-bound distempers with respect to alkali resistance, and this property can be exploited for use on fresh plastered walls which are highly alkaline, says a report by V.M. Mannari and D.A. Raval in the journal "Research and Industry".

P.T.I. Science Service, October 1-15, 1990, p. 3.

REAL-TIME MULTIPLE- TASKING FOR MICROPROCESSORS

A real-time multiple-tasking operating system that helps industrial plants detect and respond to multiple external stimuli has been designed and developed in India. The system, which can be used in both microprocessors and personal computers, has been developed by the reactor control division of the Bhabha Atomic Research Centre (BARC), Bombay, in association with the Nuclear Power Corporation.

It exhibits a degree of concurrency in responding to each individual external event, and responds rationally to events occurring in an unpredictable order. The computer programmes designed to implement such applications, usually called tasks, run independently, each task doing a specific job. The operating system allows a single processor to be switched between multiple tasks and organise all related activities, including context switching, scheduling, message passing and resource sharing, says a newsletter of the Bhabha Atomic Research Centre.

P.T.I. Science Service, October 1-15, 1990, p.p. 3,4.

ONGC DEVELOPS 3-D DATA PROCESSING TECHNIQUE

The Oil and Natural Gas Commissions (ONGC) has broken the monopoly of foreign oil companies by developing its own technology for processing three-dimensional (3-D) seismic data. The three-dimensional seismic data processing is the most powerful subsurface imaging technique in the world. Indigenous development of this technique will have a major impact on India's oil exploration efforts, according to ONGC scientists.

Until recently, the 3-D seismic data had to be sent abroad for processing since the technology has been a monopoly of a few leading geophysical companies of the world. The indigenisation of the 3-D seismic processing technique has already saved the country over one million US dollars in foreign exchange, say the Dehra Dun based scientists of ONGC's geodata processing and interpretation centre.

The technique has applications for a variety of seismic data processing job both land and the deep seas, they said in a report in the "Journal of the Association of Exploratory Geophysics". The installation of a large mainframe computer at ONGC's headquarters in Dehra Dun has helped the scientists to incorporate a technology comprising high-speed computers with large disk space.

The 3-D processing methodology has been formulated and field tested in three land and one offshore prospects successfully, the report said. According to the scientists, the "robustness of the technique is evident from its ability to handle varied kinds of data on different prospects". For instance, oil is produced from a fractured basement at a depth of 2.5 km. The fractures are believed to be due to deep seated faults and identification of these faults and delineation of the pattern is necessary to understand the accumulation of hydrocarbon in the region.

On land, the technique has come in handy for coal exploration. In 1987 when the method was first used in the country on land, the geological data indicated that coal seams were of varying thickness from six to 20 metres at depths ranging from 700-1,000 metres, the report said.

-- P.T.I. Science Service, Oct. 1-15, 1990, p. 4.

SOLVING A PLASTIC PROBLEM

With the spectre of increasing mountains of plastic garbage sending researchers scurrying for solutions, the possibilities thrown up by waste recycling and biodegradation techniques offer hope in an otherwise vexing scenario

Plastics, in recent years have infiltrated every conceivable area of human existence right from diapers used by the newborn to the most advanced rockets exploring outer space. This is particularly true in case of developed countries. For instance, the United States produces 60 billion pounds of plastic resins annually, and sales of plastic products in that country exceed 150 billion dollars a year.

Countries like India, on the other hand, are embarking on massive plastic expansion programmes and a wide range of consumer products traditionally made from wood, paper and metals will be replaced by plastics.

As plastics can be spun into fibres, moulded, or made into films with relative ease, a mind-boggling amount of plastic is expected in the next century. This has accelerated the efforts to reclaim plastic from the waste stream

The problem with plastics does not lie with the nature of its chemical composition. It can be melted down and reused like glass or aluminium. The complication in the case of plastic goods is that they are made up of different types which are incompatible. Bags may be made of low-density polyethylene, milk jugs of high-density polyethylene and soda bottles of polyethylene terephthalate. When these are recycled they can only be used for coarse purposes as substitutes for wood in boat docks, for instance. This implies that new plastics are necessary for manufacturing bags and bottles. And, the amount of plastics in the environment will naturally go up.

One way in which this can be sorted out is to separate plastics of a particular type before recycling. Bottle recycling requires a sophisticated process. First, the bottles are pulverized and cleaned. The mixture is then dumped in water, since high density polyethylene floats, it can be skimmed off. The remaining materials are charged with static electricity. Polyethylene terephthalate holds a charge and so it sticks to a charged, revolving drum. The process generates raw materials that are nearly 100 per cent pure.

Europe has it is share of problems and solutions are being spinned out. Austria, for example, throws out something like a quarter of million tonnes of plastics waste annually, more than half of it from private households. Now researchers at the Austrian Institute of Synthetic Materials in Vienna have succeeded in developing a new recycling process for plastic waste. This ''grafting'' technique allows waste consisting of mixed synthetic materials to be refined, and converted into a completely new product with new properties.

In the course of this process, a new synthetic material is added to the waste, and anchored in its molecular structure. The result is that the plastics waste is converted into high-grade material which, among other applications, can be used for electronic articles such as radio and television casings.

Largescale recycling of plastics, however seems a futuristic possibility. At present, in the US, only 0.2 per cent of plastics are recycled. In comparison, 31 per cent of aluminium is recycled. Recycling is not the only alternative for plastics disposal. A more promising option is in burning it along with other garbage in waste-to-energy plants that use the heat to produce electricity for sale. In fact, certain countries are already following this procedure. But these plants are economically unviable.

A major alternative to recycling is the manufacture of degradable plastics. Biodegradable plastics, for one, incorporate weakening agents into their chemical structures that allow fungi and bacteria to take hold and digest the hydrocarbon chains. Most of biodegrading techniques are based on a method discovered in the 1960s. A Union Carbide chemist James Potts found that organisms ate into natural polymers such as cornstarch, cellulose, cotton and silk, but they consumed only one class of synthetic polymers, that was polyesters.

These polymers have ''ester groups'' such as animal and vegetable fats and oils, bound into their chemical backbone. Enzymes from microorganisms seek out an ester group and connect with it, using water to convert it into an alcohol and acid that the organisms can then digest. Biodegradable polyesters also consists of shorter chains and have low melting points, so they can be swollen with water. This softens their molecular structure and makes them more susceptible to the work of enzymes.

In contrast to biologically degradable plastics, those that are chemically degradable do not break down completely. Instead, fillers, often starches, added during the traditional manufacturing process simply cause the material to crumble, leaving behind a residue. Although less effective, these products tend to be cheaper, since the techniques for making them are less delicate and labour intensive.

The third type of degradable plastics does its magic when exposed to light. In photodegradables, ''carbonyl groups'' — composed of ketones, carbon, and oxygen molecules — absorb ultraviolet light from the sun, triggering a chain reaction that breaks the bonds between molecules. The plastic becomes brittle and crumbles.

A new plastic material is raising hopes in the United Kingdom. Plastic containers made of polyhydroxybutyrate (PHB) developed by a British firm are said to totally biodegrade by algae, fungi and bacteria in the soil within a year or so. PHB is a natural polymer produced by fermentation of the bacteria Alcaligenes eutrophus commonly found in soil. British households, incidentally generate 18 million tonnes of plastic rubbish annually.

However, there are fears that the residues that remain after many plastics break down could contaminate groundwater supplies, as well as prove hazardous to animals that ingest them. This is coupled with the worry that degradable plastics might interfere with efforts to recycle plastics, a business that is just starting to pick up.

Americans who recycled just eight million pound of plastic soft drink bottles in 1979, recycled at least 150 million pounds in 1987, and the figure is expected to reach 600 million pounds by the mid-1990s.

A problem with degradable plastics is that they need either sunlight or moisture and oxygen depending on what type they come under. In most plastic dumps, both are not sufficiently available, and there have been instances of plastic materials retaining their characteristics several years after they have been disposed.

A section of scientists say that a balanced solution could lie in new, enlightened management of plastic dumps that combine recycling and degradable technology.

P.T.I. Science Service, October 1-15, 1990, p.p. 5,6.

CONVERTING HOUSEHOLD WASTE INTO SOLID FUEL

A Japanese company has innovated the Total Clean Energy (TE) system which transforms household waste into solid fuel without any incineration process. This means no atmospheric pollution, almost no residue for disposal, and an end product which serves as a new energy, says a report in the journal "Science and Technology in Japan".

The principal processes involved in the TE system are crushing, drying and moulding into billets. The system also treats waste water and odour, and strictly controls emissions of dust, toxic gases and noise. First, large non-flammable items are removed from the waste by hand. The waste then enters primary crushers where it is attached by a four-axis cutter, after which it passes under the first of two magnetic selectors to remove smaller metallic matter. Next, the waste enters a second crusher, in which the particle size is reduced. It will later have the last of its metallic content removed by a secondary magnetic selector.

The waste is then dried using heat generated by solid fuel recycled within the system. After drying, it is mixed thoroughly to ensure uniformity. If the waste is of low calorific value, it is blended at this state with waste of a higher calorific value so that the end product is of standard quality.

Finally the waste arrives at the billetizer, where pressure as high as 200 kg per square cm forces it into tubes one cm in diameter and five cm in length. The heat generated by the pressure and friction with the walls of the mould facilitates moulding, and produces fuel billets which are highly stable.

All waste water within the TE system, developed by the Toyo Nenki Company Ltd. based in Saitama Pref. is sent to the combustion furnace, where it is broken down by the intense heat. Odourous gases, meanwhile, are picked by suction fans located at points where the waste is exposed, and likewise fed into the furnace for burning.

The combustion furnace inevitably generates ash. This is sent to a subsystem for the processing of toxic heavy metals in industrial waste. In this, the ash is melted at high temperature. The result is a stable, vitreous sludge one-third the volume of the original ash, which can be used as a material for civil engineering, for the production of glassware etc.

P.T.I. Science Service, October 1-15, 1990, p. 14.

PERENNIAL FILTER

Scientists at the Soviet Institute of Physical Chemistry have developed filters with an unlimited service life as they are self-cleaning and do not need replacement. The filter is based on a "spring" of a specially shaped wire. This shape helps meet two goals. First, an intercoil clearance is created thereby trapping solid contaminants as efficiently as conventional materials like cermets, cloth and cardboard.

Second, under the impact of liquid or gas the coils either contract, or extend. While working in the contracted position, the spiral element purifies effluents. Extended, it self-purifies under the countercurrent liquid/gas effect. Filter productivity does not fall with time, nor does it depend on the filtration-regeneration cycle number.

The new filter is already in use. A Soviet chemical plant has six such purifying units with a total of 100 sq. metre filtering area, which efficiently trap chalk in the Norway saltpetre solution.

P.T.I. Science Service, October 1-15, 1990, p. 15.

'KAMIKAZE' VIRUSES TO KILL INSECT PESTS

Indian biologists are creating suicide squads of viruses to be unleashed on insect pests that destroy millions of tonnes of crops in the country every year. Scientists at the National Institute of Immunology (NII) New Delhi have engineered genes of a type of virus called baculoviruses which self-destruct after they have infected and killed crop-eating insects.

"When they have done their job, these Kamikaze viruses self-destruct thereby eliminating worries about their continued presence in the environment", says Dr. S. Hasnain, a scientist at NII's genetic engineering laboratory. It is too early to predict when these genetically engineered viruses will be released in field trials. But, NII researchers say, they are expected to find a place in the ongoing department of biotechnology supported programme on the biological control of pests.

Baculoviruses are fragile creatures but nature has given them the capability to make a tough protein coat, "polyhedrin" that protects them in the environment. Without this coat, these viruses cannot survive long. To make suicide squads of these viruses, the NII researchers remove the gene responsible for the manufacture of polyhedrin, thus shutting off the genetic switch that makes the protective coat.

When crippled viruses, unable to make polyhedrin, emerge in the environmental after they have infected and killed insects, they die within hours. Scientists at the Tamil Nadu Agricultural University, Coimbatore, have conducted field trials of wild (non-crippled) baculoviruses to determine their efficacy against pests of several crops. It was found that they can infect and kill several local pests.

Chemistry of Acrylic & Allied Polymers

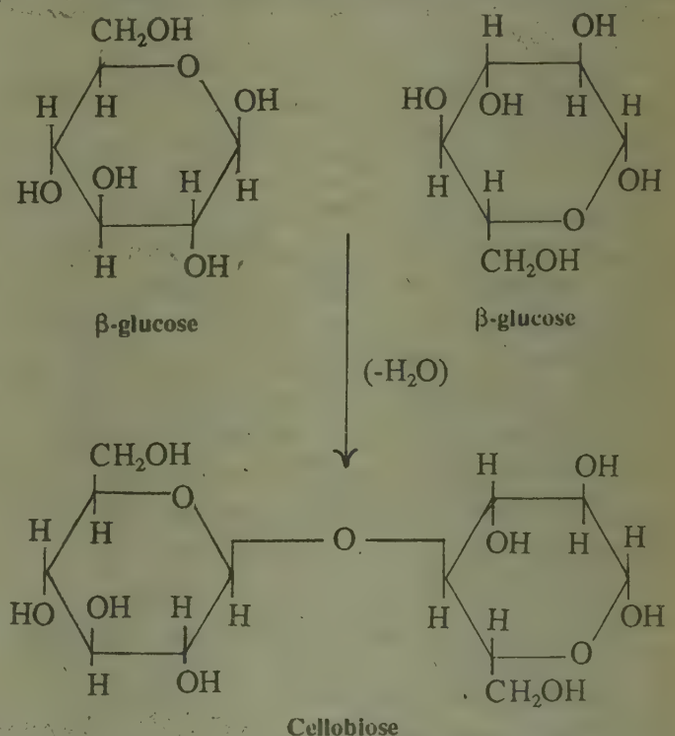
Prof. V.A. SHENAI
Department of Chemical Technology, University of Bombay

If one is asked to describe the hand (or handle) of a finished fabric, various words describing the qualities of the fabric come to one's mind. Generally, they concern two opposite qualities (called polar adjectives) such as soft-firm, limp-stiff, supple-crisp, lofty-thin, heavy-light (all these refer to the body of the fabric); hard-soft, clean-fuzzy, smooth-thready, full-lean, and dense-sheer (these refer to the cover of the body); compact-loose, rough-smooth, soft-hard, flimsy-firm, bulky-not bulky, flat-textured, thick-thin, harsh-gentle, and warm-cool (these refer to the qualities of fabrics intended for sleepwear). The hand of a fabric can be described by four mental processes that are sensitive to (a) smoothness, (b) stiffness, (c) compactness or bulk, and (d) thermal character. There are four sensory centres in the hand (finger tips, palm, etc.) of a person: (a) sensors of surface smoothness and roughness, (b) sensors of stiffness and flexibility, (c) sensors of evaluation of bulk properties (size, weight and form), and (d) sensors for heat and cold (thermal centre). These coincide with the above four processes which describe the fabric hand.

The hand of a fabric is a combination of the properties of the fibre/fibres (inherent properties), the characteristics of the yarns (twist, hairiness etc.), the nature of the fabric (tightness of the weave, density of the pile etc.), the type of the finishing agent deposited in and/or reacted with the fabric on the one hand, and the subjective assessment of the person handling the fabric on the other. A loosely woven fabric is very limpy, which can be converted into a stiff fabric, the stiffness being purely temporary (using starch), semi-permanent (using homopolymer of vinyl acetate) or durable (using self-crosslinking acrylic copolymer); the stiffness may further be modified by imparting a certain degree of flexibility (by having internal or external plasticization). A tightly woven fabric (say, canvas) has some built-in stiffness, which can be softened by depositing or reacting certain finishing agents like polyethylene emulsion, pure and modified silicone softeners, ionic and nonionic softeners, reactive softeners etc. Resiliency (bouncing property) can be imparted to a fabric by applying styrene/butadiene copolymer emulsions. Application of suitable polyacrylic and polymethacrylic copolymers or terpolymers produces a variety of properties in fabrics. These products can be used as textile sizes, finishing agents, coating formulations, nonwoven fabric binders, pigment binders for use in dyeing or printing, flame-retardant coating etc. With a judicious choice of monomers and carrying out the polymerization to the required extent, products with tailor-made properties can be synthesized to get the desired effects on fabrics made from natural fibres, synthetic fibres and their blends. The chemistry of acrylic and allied polymers is being discussed in detail in the following.

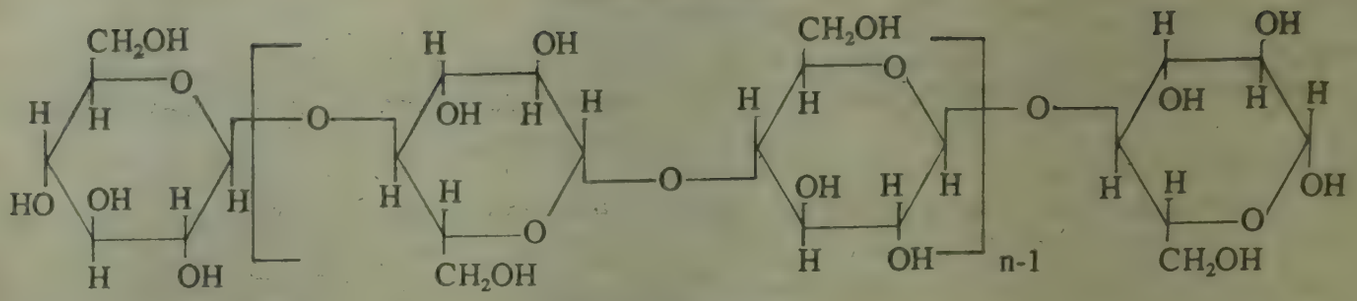
Definitions

Nature produces many high molecular weight substances such as cellulose, proteins, starch, gums, rubber, resins etc. The molecular weight of these substance runs into tens of thousands to hundreds and thousands of thousands. Some of these are linear molecules, built up of one or more primary or building units, linked in a regular manner and provide the basic materials for fibres. Thus, two molecules of ß-glucose react with one another to form cellobiose, which is the building unit of cellulose, the main constituent of cotton fibre:



Anywhere from 1,000 to 1,500 cellobiose units join in a linear manner to give a cellulose macromolecule, so that each macromolecule contains 2,000-3,000 ß-glucose units. In fact, not all the macromolecules are of the same length. The average number of ß-glucose units in the macromolecule is called the degree of polymerization (DP) of the cellulose (see structure on next page).

It is seen that each of the 2n-2 ß-glucose units (shown in the brackets) are identical with others, in that each of them contains one primary hydroxy group and two secondary hydroxy groups and is linked to the adjacent ß-glucose units by oxygen bridges. The two ß-glucose units (at the ends) differ from the interior units and among themselves too. Thus the one at the left-end has an additional secondary hydroxy



Cellulose macromolecule

group and the one at the extreme right has an additional hemi-acetal group. The following names may be given to the different parts of the macromolecule. The entire product, cellulose, comprising the macromolecules is a polymer (many parts). Cellobiose is the monomer (one part) from which the polymer is made. Cellotriose, cellotetrose, and cellopentose may be called oligomers (few parts).

The cellobiose radical, which is a repeating radical, which when combined with other mesomers forms the principal portion of the polymer macromolecule (portion shown in the brackets in the above formula), is called mesomers (middle part).

Some monomers and polymers made from them are shown in Table 1.

When a monomer like ethylene is polymerized, very high molecular weight polyethylene can be prepared. However, the polymerization can be terminated at a desired molecular weight. This is done by various ways. In one, a simple compound, which may be split up to form monovalent terminating groups, is used. Such a compound is called a Telogen (end generation) and each terminated ion is called a telomer (end part). Thus hydrogen chloride can be used as a telogen in the preparation of polyethylene, which then is called a telomerized polymer.

$$\underset{\text{(Monomer)}}{n\ CH_2 = CH_2} + \underset{\text{(Telogen)}}{HCl} \longrightarrow \underset{\text{(Telomerized Polymer)}}{H\text{-}(CH_2\text{-}CH_2)_nCl}$$

Other methods of terminating polymerization will be dealt with later, while describing the use of free radicals in addition polymerization.

Polymerization is a chemical process occurring when simple molecules react to form polymers. Condensation and addition polymerizations are generally used to produce polymers. Condensation polymers may be defined as those in which the molecular formula of the mesomer lacked certain atoms present in the monomer from which it was formed (or to which it might be chemically degraded).

A process which occurs by reaction between pairs of functional groups and which forms a type of inter-unit functional group, not present in the reactant or reactants is considered to be a condensation process. Generally, ester and amide functional group join the mesomers in polymers prepared by condensation polymerization:

$$n\ HO.R.COOH \longrightarrow H\text{-}(O\text{-}R\text{-}CO)_{n-1}O\text{-}R\text{-}COOH + (n\text{-}1)\ H_2O$$

$$n\ H_2N\text{-}R\text{-}COOH \longrightarrow H\text{-}(HN\text{-}R\text{-}CO)_{n-1}HN\text{-}R\text{-}COOH + (n\text{-}1)\ H_2O$$

$$n\text{-}HO\text{-}R'\text{-}OH + nHOOC\text{-}R\text{-}COOH \downarrow$$

$$H\text{-}(OR'OOC.R.CO)_{n-1}O.R'\text{-}OOC.R\text{-}COOH + (2n\text{-}1)H_2O$$

$$n\ H_2N\text{-}R'\text{-}NH_2 + nHOOC.R\text{-}COOH \downarrow$$

$$H\text{-}(HN\ R'\ NHCO\text{-}R\text{-}CO)_{n-1}HN\text{-}R'\text{-}NH\text{-}COOH + (2n\text{-}1)\ H_2O$$

In the above equations R is a divalent alkyl or aryl group. Some of the important textile fibres are made by condensation polymerization (Table 2).

Addition polymers are those in which the molecular formula of the mesomer is identical with that of the monomer from which it is derived. In addition polymerization, the polymers always consist of C-C links in the main chain, though side functional groups like acidic, amide, halide, ester, etc. may be present. This basic difference between condensation and addition polymers produces appreciable chemical and physical differences between the two types of polymers. Thus the condensation polymers are more prone to hydrolysis than addition polymers. Addition polymers are already mentioned in Table 1.

When a single monomer is used in polymerization, a homopolymer is produced. A copolymer is the product made by polymerizing two monomers, while a terpolymer is made by polymerizing three monomers. Copolymers and terpolymers are made by selecting suitable monomers and comonomers to get the desire property in the final polymer.

Functionality of Monomers

Functionality of a monomer is its ability to form primary valence bonds or it is the number of positions in a molecule normally available for reaction under a given set of conditions of the experiment. A molecule must be bi- or polyfunctional (functionality 2 or more) for it to be able to take part in a polymerization reaction. Compounds containing two or more functional groups include hydroxy acids, amino acids,

dicarboxylic acids and diamines, diols and dicarboxylic acids, diols and di-isocyanates, diols and diamines etc.

Polyfunctional molecules have one or more additional functional groups. These molecules react with each other through their chemically active groups and form linear or three-dimensional molecules containing, ester, aimide, urethane, ureide and other groups, giving polyesters, polyamides, polyurethanes, polyureides, etc.:

$$\underset{f=1}{R\text{-}COOH} + \underset{f=1}{HOR'} \longrightarrow \underset{f=0}{R\text{-}COOH'} + H_2O$$

Table - 1

SOME MONOMERS AND POLYMERS

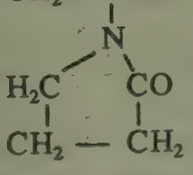
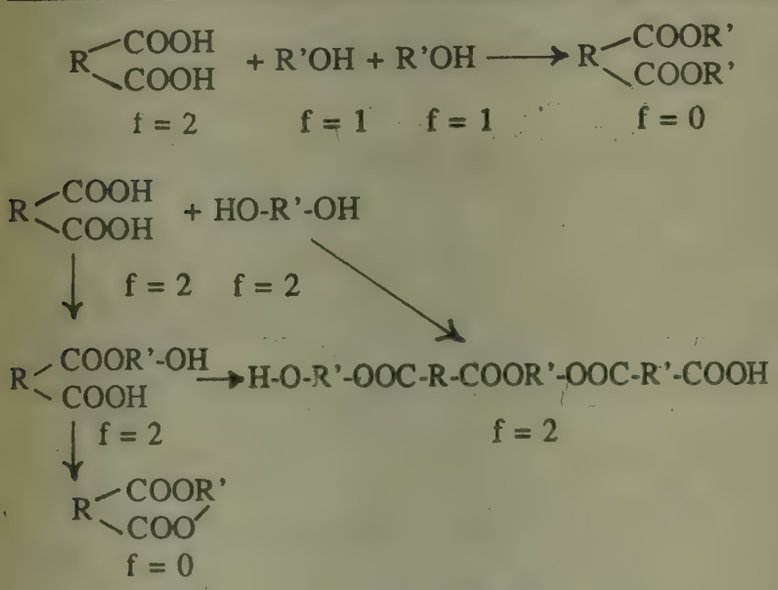
Monomer	Structure	Polymer
1. Ethylene	$CH_2 = CH - H$	Polyethylene
2. Propylene	$CH_2 = CH - CH_3$	Polypropylene
3. Acrylic acid	$CH_2 = CH - COOH$	Polyacrylic acid
4. Acrylamide	$CH_2 = CH - CONH_2$	Polyacrylamide
5. Vinyl acetate	$CH_2 = CH - OOC.CH_3$	Polyvinyl acetate
6. Methyl acrylate	$CH_2 = CH - COOCH_3$	Polymethyl acrylate
7. Butyl acrylate	$CH_2 = \underset{\displaystyle COOC_4H_9}{\underset{\vert}{CH}}$	Polybutyl acrylate
8. Methacrylic acid	$CH_2 = \underset{\displaystyle COOH}{\underset{\vert}{C}} - CH_3$	Polymethacrylic acid
9. Methyl methacrylate	$CH_2 = \underset{\displaystyle COOCH_3}{\underset{\vert}{C}} - CH_3$	Polymethyl methacrylate
10. Vinyl chloride	$CH_2 = CH\text{-}Cl$	Polyvinyl chloride
11. Vinylidene chloride	$CH_2 = \underset{\displaystyle Cl}{\underset{\vert}{CCl}}$	Polyvinylidine chloride
12. Styrene	$CH_2 = CH$	Polystyrene
13. Divinyl benzene	$CH_2 = CH$ $CH_2 = CH$	polydivinylbenzene
14. Vinyl pyridine	$CH = CH_2$	Polyvinylpyridine
15. Vinyl pyrrolidone	$CH_2 = CH$ 	Polyvinyl pyrrolidone
16. Ethyl acrylate	$CH_2 = CH - COOC_2H_5$	Polyethyl acrylate
17. Acrylonitrile	$CH_2 = CH - CN$	Polyacrylonitrile
18. 1,3-Butadiene	$CH_2 = CH - CH = CH_2$	Polybutadiene

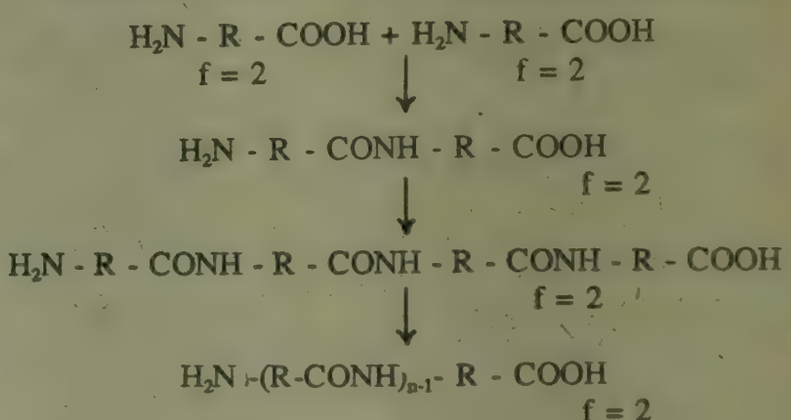
Table - 2
RAW MATERIALS FOR SOME TEXTILE FIBRES

Fibre	Raw Material	Structure
1. Nylon 6	ε-Amino caproic acid	$H_2N-(CH_2)_5-COOH$
2. Nylon 66	Hexamethylene diamine and Adipic acid	$H_2N-(CH_2)_6-NH_2$ and $HOOC-(CH_2)_4-COOH$
3. Polyester	Terephthalic acid and Ethylene Glycol	HOOC-C$_6$H$_4$-COOH and $HO-CH_2-CH_2-OH$
4. Aramid	Terephthaloyl chloride and p-Phenylene diamine	Cl-CO-C$_6$H$_4$-COCl and $H_2N-C_6H_4-NH_2$
5. Aramid	Terephthaloyl chloride and m-Phenylene diamine	ClCO-C$_6$H$_4$-COCl and $H_2N-C_6H_3(NH_2)$

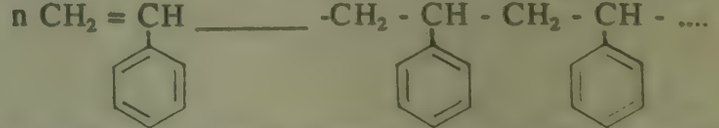


In the above scheme, when an acid and an alcohol (both of monofunctionality) react, an ester of zero functionality is produced and further reaction does not proceed. When a diacid and an alcohol react, a diester with zero functionality is produced. This too cannot react further. If a diacid reacts with a diol either a monoester with bifunctionality is produced, or a triester, again with bifunctionality is produced which can go on reacting with itself producing a polyester. At the end of every reaction the product formed is a bifunctional one. However, in the initial stages, a cyclic diester can be formed, which then does not take part in polymerization reaction since its functionality is zero.

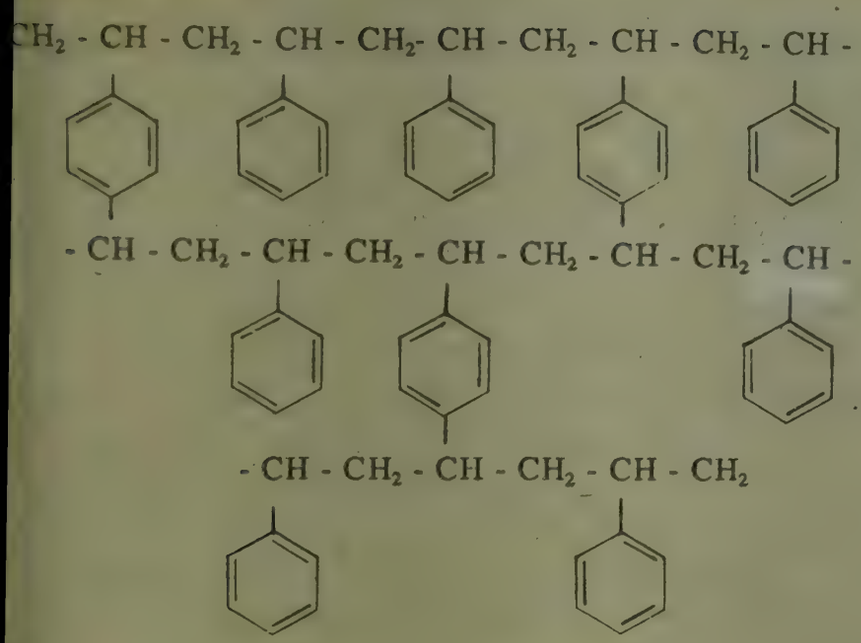
An amino acid (with bifunctionality) produces a monoamide, diamide, triamide etc., and finally a polyamide:



Molecules containing unsaturated bonds exhibit another type of bifunctionality or polyfunctionality. Once a double bond is opened and a bi-radical is formed, other monomers collide with its active ends, starting the growth of a chain molecule — extending in both directions from the original biradical. Thus styrene produces polystyrene:



This produces randomly disposed chains tangled together but not linked to each other by covalent bonds. When heated, polystyrene becomes soft and is readily distorted by the application of mechnical stress; when cooled, it becomes rigid again and retains the shape impressed upon it when hot. Polystyrene dissolves in benzene to give a colloidal solution. However, when a small amount (0.002%) of divinyl benzene is added during the polymerization of styrene a crosslinked three-dimensional network is formed:



The resulting crosslinked polymer is insoluble in benzene, though it swells the polymer. This implies that when a polymer is soluble in water or an organic solvent, its solubility in it can be removed by introducing a small amount of a monomer containing a crosslinking group in the polymer chain. This assumes great importance in finishing of fabrics with water-soluble finishing agents which produce the desired effect that last only one or two washes since the product applied is soluble in water. If the polymer contains reactive groups introduced by the method described above, the group may react with the fibre (say, cotton) or with another reactive group thereby becoming water-insoluble, leading to the production of durable finishing effect. For example, copolymerization of an alkyl acrylate or methacrylate (ethyl acrylate, n-butyl acrylate, methyl methacrylate etc.) with a small amount of a monomer containing a reactive group of, say, monofunctionality like hydroxy ethyl ($-CH_2-CH_2-OH$), hydroxymethyl ($-CH_2-OH$), aminoethyl ($-CH_2-CH_2-NH_2$), glycidyl ($-CH_2-CH_2-CH_2$) etc. produces such a reactive

polymer.

Various types of polymers are formed — linear, branched, and crosslinked. When a monomer is polymerized, a homopolymer is formed (ethylene to polyethylene, acrylic acid to polyacrylic acid etc.). If A is the monomer, the linear homopolymer molecule may be shown as

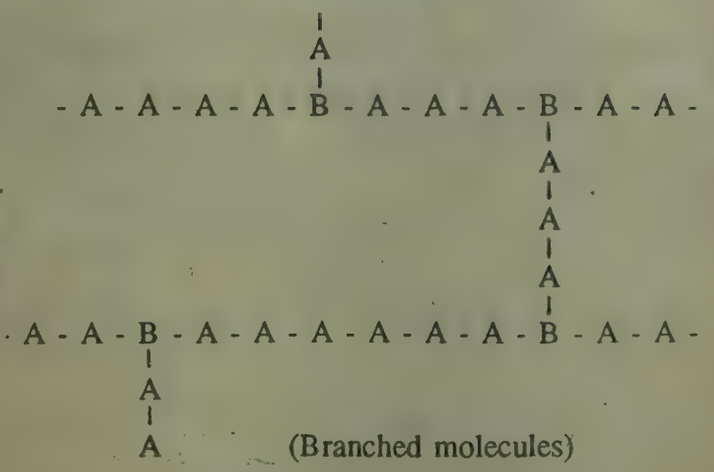
- A - A - A - A - A - A - A - A - A -

(Linear molecule)

If a small amount of a trifunctional monomer (B) is added, a branched polymer molecule is formed (see Structure A)

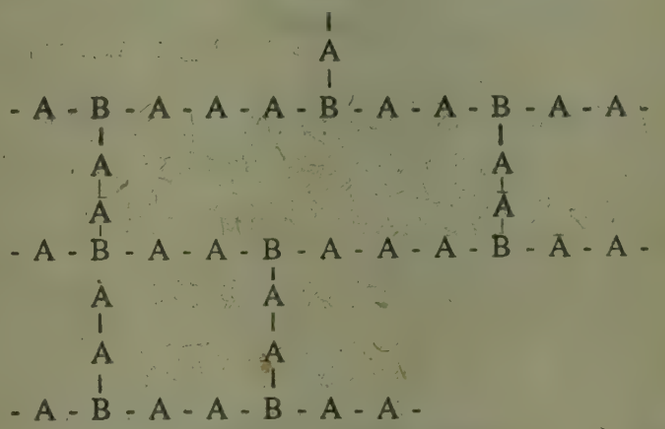
It still larger amount of the trifunctional monomer (B) is used, a crosslinked structure is produced (see Structure B):

Structure A



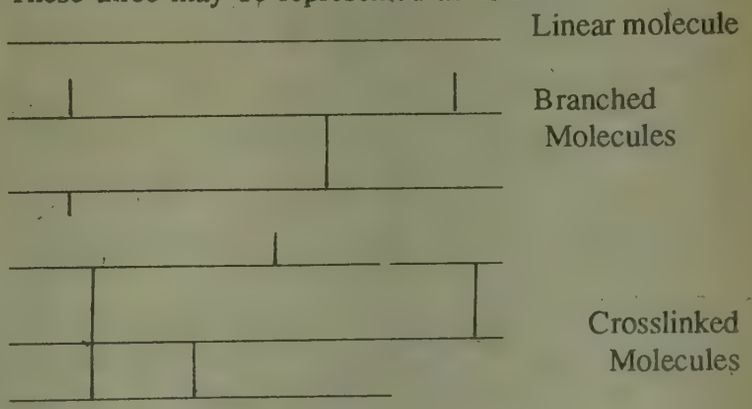
(Branched molecules)

Structure B



(Crosslinked molecules)

These three may be represented as follows:

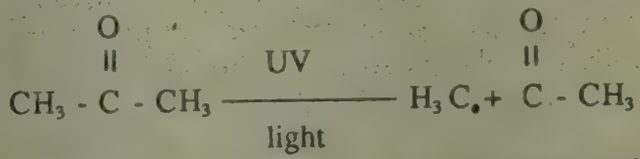


Reactive species

Organic compounds undergo various reactions such as substitution, addition, elimination, rearrangement, etc. They may form intermediate reactive species before forming the final products. Let us consider the nature of the reactive species formed. In the case of methyl chloride, the covalent bond between carbon and chlorine was formed by two electrons, one from each of the atoms and the electron pair is shared by both. For methyl chloride to react, this bond should be broken, which can be done by (a) homolytic fission (or scission) of the bond, when each of the atoms retain one elec-

tron while separating, giving two species, called free radicals, each containing one unpaired electron, or (b) heterolytic scission of the bond, when one of the atoms retains both the electrons, thereby acquiring a negative charge, while the other species is short of one electron, thereby becoming positively charged. Thus, whereas homolytic scission of the covalent bond produces electrically neutral free radicals, the heterolytic scission gives rise to positive and negative ions:

(a) Homolytic scission



(Two free radicals)

(b) Heterolytic scission

(i) When the carbon atom loses the electron pair and the chlorine atom gains it, a **carbonium** cation and a chloride anion are formed:

(Carbonium ion)

(ii) When the carbon atom retains the electron pair and the other loses it, a carbanion is formed:

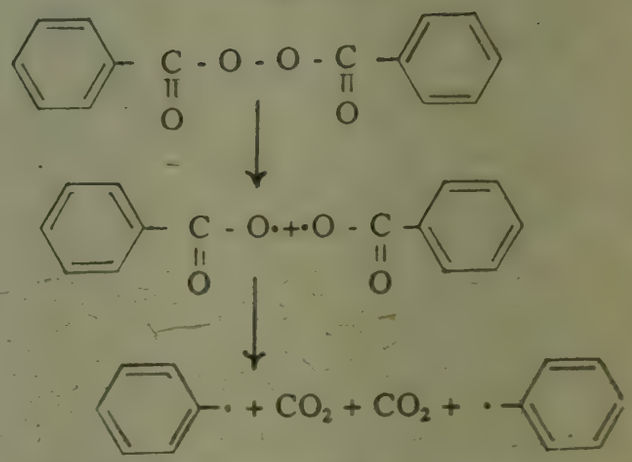
(Grignard reagent) (Carbanion)

Homolytic fission is called homolysis. The free radicals thus formed are very reactive since they contain unpaired electrons. When free radicals react with each other the unpaired electrons of two free radicals get paired with the formation of a stable covalent bond.

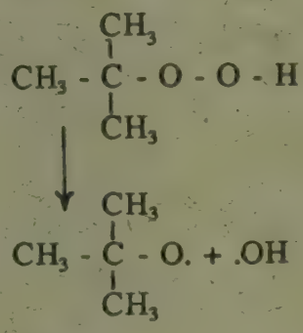
Free radicals may be formed by (1) the photochemical (irradiated by ultraviolet light) or thermal decomposition of an organic peroxide compound, or (2) a redox system. Thus benzoyl peroxide decomposes slowly at 50-150°C with the release of free radicals. (See Structure C)

One molecule of benzoyl peroxide gives two free radicals (either carboxy and hydrocarbon free radicals). At higher temperatures, the hydrocarbon free radicals are obtained with the liberation of carbon dioxide.

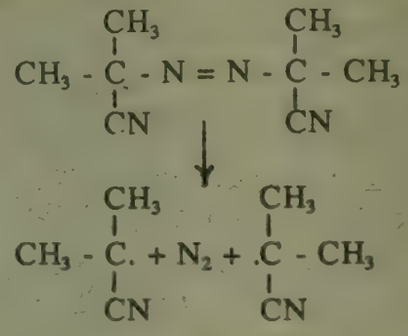
Structure C



Organic hydroperoxides, such as tert. butyl hydroperoxide produces (on heating) two free radicals:

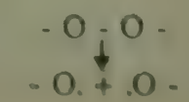


Aliphatic azobisnitriles, like azobis-isobutyronitrile (AIBN) gives two free radicals on heating:

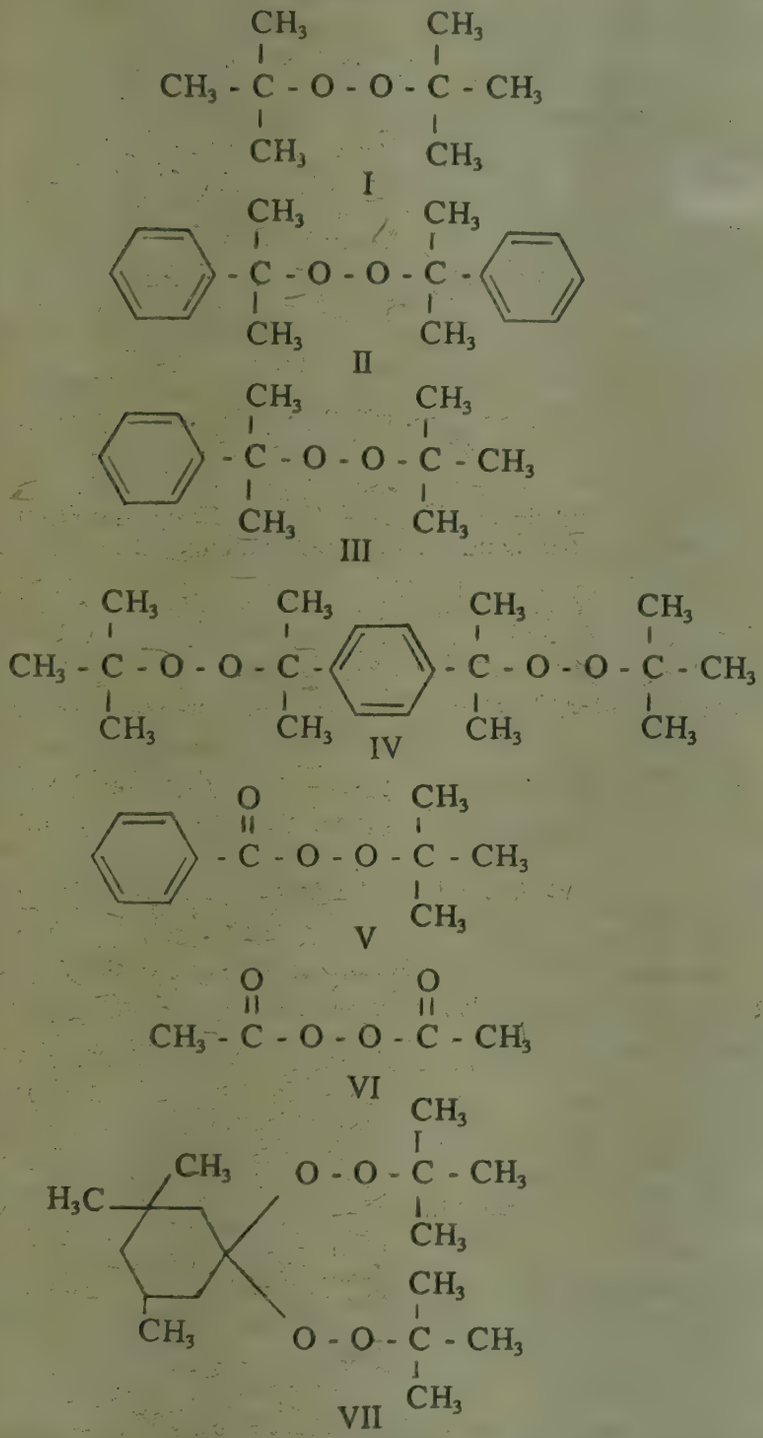


The other compounds producing free radicals include alkyl peroxides (ditert. butyl peroxide, I), diaralkyl peroxide (dicumyl peroxide, II), alkyl aryl peroxide (tert. butyl-cumyl peroxide, III), bis (tert. butyl peroxyisopropyl) benzene, IV), peroxy esters (tert. butyl peroxybenzoate, V), diacyl peroxide (diacetyl peroxide, VI), peroxyketals (1,1-di-tert. butyl peroxy-3,3,5- trimethyl cyclohexanone, VII), etc. (See Structure D)

In all the above cases, the peroxy bond, -O-O-, has a bond energy of 30 kcal/mole, which can be easily supplied either by heating or by exposure to ultra violet light to produce free radicals



Structure D



Redox system

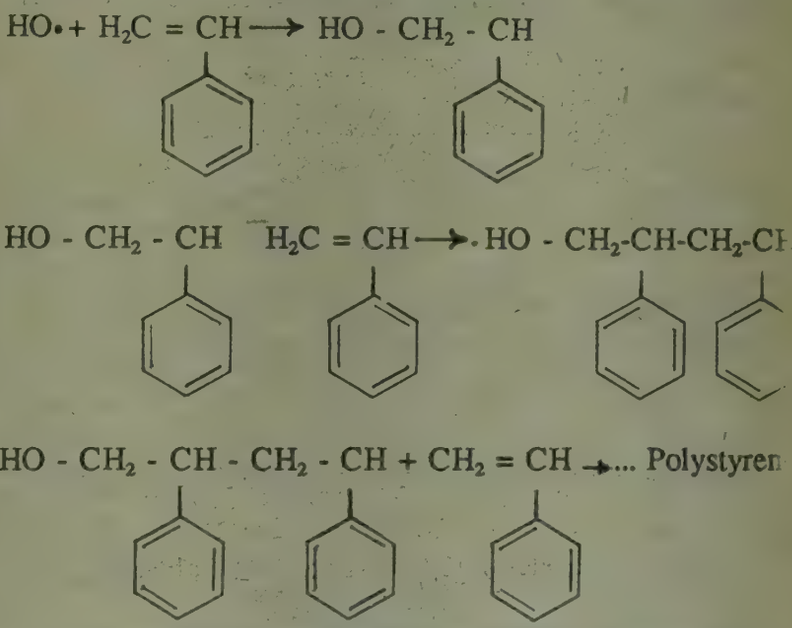
In this system, the decomposition of an oxidizing agent occurs under the influence of a reducing agent to produce a free radical. In contrast to free radicals initiated by the thermal decomposition of organic peroxides, the free radicals generated by a redox system are usually formed by the reaction of inorganic materials in ionic form in an aqueous medium. Ferrous sulphate/hydrogen peroxide, potassium persulphate/sodium thiosulphate, and potassium persulphate/sodium metabisulphite are the better known redox systems.

$$Fe^{++} + H_2O_2 \longrightarrow Fe^{++} + OH^- + HO.$$
$$S_2O_8^{--} + S_2O_3^{--} \longrightarrow SO_4^{--} + SO_4^{-}. + S_2O_3^{-}\cdot$$
$$S_2O_8^{--} + HSO_3^- \longrightarrow SO_4^{--} + SO_4^{-}. + HSO_3^{\cdot}$$

Addition polymerization

Free radicals play an important role in addition polymerization. Unsaturated monomers polymerize by a chain reaction mechanism. Organic compounds containing a particular type of double or triple bonds have a tendency to polymerize. The unsaturated compounds must be in a pure state, as impurities do not allow polymers of uniform quality to be made. Olefinic (ethylenic , $CH_2 = CH$-; and propylenic, $CH_2 = C(CH_3)$ monomers are the most important ones in the commercial production of addition polymers, because of the low cost of the raw materials, cost of production, ease of purification, and control of reaction. The double bond is the site of the initiating reaction that gives rise to active centre, which may add on a monomer molecule without the loss of activity. The chain grows by successive additions of monomer until by some method, it becomes stabilized and the growth stops.

Thus hydroxyl radicals can be used to initiate polymerization of styrene to form polystyrene:



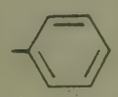
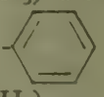
The chain process proceeds in three steps — initiation, propagation, and termination. Activation of the monomer M (initiation) is followed by the addition of other monomers in quick succession (propagation), until the growing chain is deactivated (termination), resulting in the production of the polymer, M_n from n monomer molecules:

$$M \longrightarrow M. \longrightarrow MM. \longrightarrow MMM. \longrightarrow M_n$$

Activation Propagation Deactivation

The entire synthesis of Mn from unreacted nM molecules occurs very rapidly, usually within a few seconds, but the conversion of all monomers to polymer may require hours. Therefore at any time during the polymerization process, the reaction mixture contains monomer and high-molecular weight polymer. The amount of the material at intermediate

Table - 3
ETHYLENIC MONOMERS, $CH_2 = CH\ X$

Name	X	Formula
Ethylene	-H	$CH_2 = CH_2$
Vinyl chloride	-Cl	$CH_2 = CHCl$
Acrylonitrile	-CN	$CH_2 = CHCN$
Vinyl acetate	$-OOC-CH_3$	$CH_2 = CH.OOC.CH_3$
Methyl acrylate	$-COO-CH_3$	$CH_2 = CH-COOCH_3$
Methyl methacrylate	--	$CH_2 = C(CH_3)-COOCH_3$
Styrene		$CH_2 = CH$ 
Isobutylene	--	$CH_2 = C(CH_3)_2$

stages of growth is so small that it cannot be measured, but its concentration, though small, is constant. As the conversion to polymer increases, the number-average degree of polymerization of the polymerized portion remains constant. Thus the duration of an addition polymerization process is determined by the yield of the polymer and not by the molecular weight required. Molecular weights greater than 100,000 can be easily obtained in addition polymerization.

Ease of polymerization

An unsaturated monomer containing two or more double bonds or having one or more triple bonds polymerizes more readily than that with only one double bond. If the double bonds form a conjugated system, as in 1,3-butadiene, $CH_2 = CH - CH = CH_2$, polymerization occurs more readily than when the double bonds are further apart. A monomer with two conjugated triple bonds is still more reactive than that with two conjugated double bonds. Greater the degree of unsaturation, greater is the ease of polymerization.

Ethylenic monomers can be represented by $CH_2 = CH —X$ where X changes. Some of these are shown in Table 3.

Ethylene is the simplest monomer which can be polymerized with some difficulty. The introduction of a negative group increases its reactivity. Thus vinyl chloride can be easily polymerized, and vinyl bromide polymerizes more readily, whereas vinyl iodide polymerizes more readily than any of the vinyl monomers; chloroprene polymerizes 700 times as fast as isoprene, whereas bromoprene, 1000 times as rapidly as isoprene:

$$H_2C = CH - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} = CH_2$$

(Isoprene)

$$H_2C = CH - \underset{\displaystyle Cl}{\overset{\displaystyle |}{C}} = CH_2$$

(Chloroprene)

$$H_2C = CH - \underset{\displaystyle Br}{\overset{\displaystyle |}{C}} = CH_2$$

(Bromoprene)

Acetate, carboxylic and phenyl groups are considered negative groups; so vinyl acetate, acrylic acid (and its esters) and styrene can be polymerized easily. Alkyl groups decrease the ease of polymerization and higher molecular weight olefins require more rigorous conditions for polymerization.

When a second substitutent is added, the reactivity of the monomer varies with the position to which it is attached; asymmetrical derivatives are more reactive than symmetrical derivatives. Thus in the case of hologenated ethylene, the ease of polymerization decreases in the order

$CH_2 = CCl_2$ (Vinylidene chloride) > $CH_2 = CHCl$ (Vinyl chloride) > Cl-CH = CHCl (Sym. dichloroethylene)

Further chlorination to give trichloroethylene ($ClCH = CCl_2$) stabilizes the molecule, which can even be used as a solvent. Methacrylic acid polymerizes easily but not as easily as acrylic acid.

Generally monomers, which polymerize easily also form high molecular weight polymers and those which polymerize with difficulty form low molecular weight polymers under similar conditions of polymerization.

Of the two methods of polymerization — redox system and organic peroxide system (both producing free radicals needed for polymerizing) — the activation energies of the former have been reported to be approximately one-third those of the later system. The efficiency of the redox system is due to the fact that while a small amount of oxygen accelerates polymerizations by the formation of peroxides, larger amounts will compete with monomers for the active nuclei and inhibit the polymerization. The effect of excess oxygen is overcome by the presence of a reducing agent. Which redu-

ces the peroxide to an active radical as soon as it is formed.

Inhibition/Retardation

Addition polymerization is susceptible to both activation and inhibition. An induction period (when no polymerization occurs) has been observed in many of the early investigations of addition polymerizations. Now it is known that the addition of certain compounds (inhibitors) inhibit polymerizations for a fixed time, after which the reaction takes place at its normal rate. In fact, the traces of impurities present in the monomers can act as inhibitors; hence absolutely pure monomers have to be used in the production of polymers.

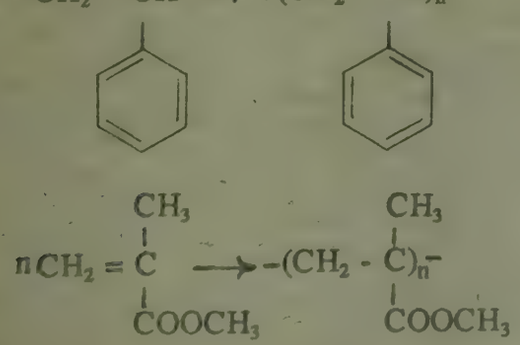
Inhibitors act in different ways. Some substances completely prevent polymerization. It is believed to act by combining with and thus deactivating the active centres as soon as they are formed and in the process it itself gets consumed. Thus there is an induction period when there is no polymerization taking place, followed by the normal polymerization after all the inhibitor is consumed. The induction period is proportional to the amount of the inhibitor present and not on its concentration. It depends on the rate of generation free radicals.

Secondly, the inhibitor may not completely deactivate the active centres, in which case polymerization takes place without an induction period, but at a slower rate than that in the absence of the inhibitor.

A number of substances may be used as inhibitors in addition polymerization. They include hydroquinone, phenols, aromatic nitrocompounds, sulphur, free radicals and oxygen.

Mass polymerization

This is also known as block, bulk or cast polymerization. Here, only one phase exists, initially. Frequently, the unreacted monomer acts as a solvent for the polymer, i.e., the polymer is compatible with the monomer. Polymerization of styrene or methyl methacrylate to get homopolymers is an example of this type



During the course of polymerization, the viscosity of the liquid gradually increases until the whole mass solidifies into a clear, homogeneous mass. Some other monomers like acrylonitrile, vinylidene chloride etc. give polymers which are not compatible with them. In such cases, mass polymerization results in the production of two phases during the later stages of polymerization. Such polymers get precipitated as they are formed above a minimum molecular weight.

In both cases (monomer and polymer are compatible, and they are not) initiation takes place in the monomer phase. In addition polymerization, the initiator (organic peroxide) is present. Condensation polymerization does not need a catalyst; usually a trace of an acid may be used, if necessary. Initiators and catalysts should be soluble in the monomer. When the addition polymer is insoluble in the monomer, the propagation of polymerization occurs in the monomer-swollen, precipitated polymer particles and a polymer of very high molecular weight is obtained.

Mass polymerization is the simplest system known. Since no added medium is needed there are no separation, purification and recovery steps after the polymerization is complete. The products obtained are inherently in a pure state. However, there are certain disadvantages of mass polymerization. Thus, these reactions are highly exothermic. In most ethylenic polymers heat energy of 20,30 kcal/mole of the monomer reacted is released. Hence heat removal and maintaining of a uniform temperature are necessary. The system being homogeneous throughout the process, the viscosity of the reaction mass increases until solidification occurs. Hence agitation to maintain uniform temperature becomes extremely difficult and eventually impossible. If agitation/stirring is used, heavy and powerful stirring equipment and elaborate cooling systems are necessary. The centre of the mass having the least heat control may get overheated, causing increased reaction rate, which, in turn, liberates more heat, raising the temperature further. The cycle may continue until reactions of explosive violence may occur. In any case, solid polymers are produced, which may not be uniformly polymerized throughout the mass, broadening the molecular weight distribution.

Mass polymerization is more suited to condensation polymerization, as this type of reaction is less exothermic than addition polymerization.

Solution polymerization

This is also known as solvent polymerization. For this purpose, the monomer is dissolved in an inert solvent such as a hydrocarbon (typically xylene). The polymer may not be soluble in the solvent or in its monomer. Catalysts/initiators used are organic peroxides. The use of the inert solvent redu-

ces the monomer concentration, thereby decreasing the rate of polymerization in proportion to the decrease in the monomer concentration and the molecular weight of the polymer is also lowered.

During the polymerization process, the volatile solvent used may maintain a blanket of its vapour, which effectively screens air (oxygen of the air), thereby keeping the oxygen content and the peroxide content low. This ensures the production of a high molecular weight polymer. Secondly, a part of the volatile solvent may evaporate as the temperature rises during polymerization, thus providing internal cooling by absorbing the latent heat of evaporation. Thirdly, the solvent lowers the viscosity of the reaction mixture, permitting the polymerization to be carried out without excessive local temperature rise (which is not the case with highly viscous reaction mixtures) and the rate and extent of polymerization are more uniform throughout the mass.

Emulsion polymerization

This technique of polymerization involves the use of the following:

1. Dispersion medium
2. Monomer/monomers
3. Emulsifying agents
   (a) Surface tension regulators
   (b) Buffers
   (c) Protective colloids
4. Initiators
   (a) Activators
   (b) Polymerization regulators or modifiers.

Dispersion medium

This is the continuous phase of the system and acts as the suspending medium for the dispersed phase. The main requirement of the dispersion medium is that it should be inert to the dispersed phase. Generally, water is used for the purpose.

Dispersed phase

Water-insoluble (solid) or water-immiscible (liquid) monomer (for copolymerzation) form the dispersed phase, which may comprise up to 75% of the whole system.

Emulsifying agent

Since polymerization in emulsion polymerization technique occurs at the inter-phase of two phases (water and the monomer phases), the inter-facial tension between the two should be reduced considerably to allow the reaction to take place rapidly. Emulsifying agents ensure easy emulsification and stable emulsions to be made with simple agitation (stirring). Common soaps, salts of long-chain carboxylic and sulphonic acids, sodium dodecylbenzene sulphonate (anionic), and amine salts of fatty amines (cationic) are some of the suitable emulsifying agents used.

As the system changes from monomer emulsion to polymer emulsion, a change in the interfacial tension occurs. Surface tension regulators are added to help maintain the interfacial tension between the two phases as the polymerization progresses. Certain aliphatic alcohols (upto 0.5% of monomer) are effective.

Suitable buffers are used to maintain the pH of the reaction mixture at the optimum level.

Protective colloids

Casein, glue, gelatine, dextrin, globulin, hydrolyzed starch, polyvinyl alcohol, carboxymethyl cellulose are used as the protective colloids, i.e., to prevent the premature precipitation of the monomer or the polymer, and to prevent adhesion of the sticky, partially polymerized, products obtained during the intermediate stages of polymerization.

Initiators

In emulsion polymerization, water-soluble initiators are used. With these, the polymer chains originate in the aqueous (dispersion) medium and then continue their growth in the dispersed places (monomer-polymer phase). The separation of the growing polymer molecules from the aqueous phase appears to shield them from chain-terminating agents, with the result that products of very high molecular weight can be formed in a very short time.

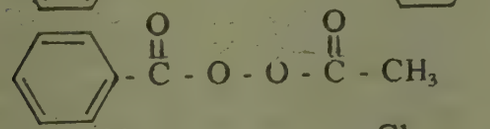
Suspension polymerization

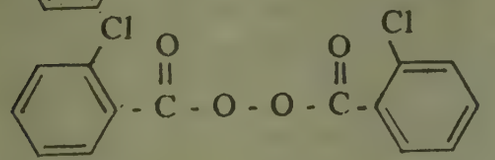
This technique is also known as bead or pearl type polymerization. One of the disadvantages of emulsion polymerization is the difficulty in coagulating and separating the polymer from the reaction mixture. Very fine precipitates are obtained which filter slowly, making the removal of the coagulating salts and initiator residues slow, expensive and incomplete. Suspension polymerization has been designed to overcome some of the disadvantages and to produce a granular product directly. As in emulsion polymerization there is a dispersion (or suspension) medium and a dispersed phase, the difference being in the particle size of the latter. The monomeric particles are much larger (1-10μ). Emulsion does not exist, but there is a simple physical suspension of polymerising drops or beads, which coalesee rapidly when the agitation is stopped.

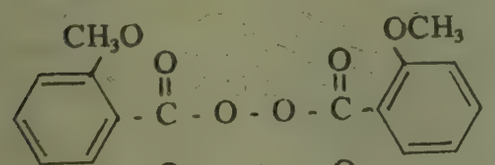
In addition to the suspended phase and the suspending medium, polymerization initiators and suspension stabilizers (like protective colloids) are also used. Generally, the suspending medium is water, though inert organic solvents may also be used and the final polymers should be insoluble in this medium.

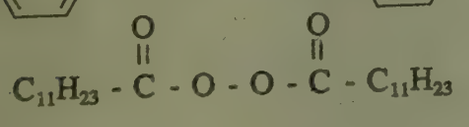
The suspended phase comprises the monomer/monomers to be polymerized and the polymerization initiator. There is no emulsifier to establish intimate contact between the two phases. Hence each bead or pearl of the monomer acts as a minute, discrete mass polymerization system. For this reason, when copolymerization is carried out, only those monomers, which react under mass polymerization system, should be selected in suspension polymerization. Similarly, mutual inhibition of monomers occurring in mass systems, also occurs in a suspension system.

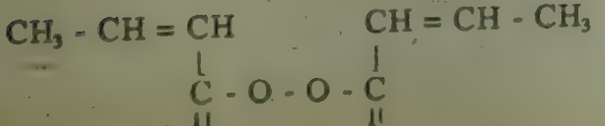
Initiators or catalysts accelerate the reaction or shorten the inhibition period. In this case, solvent soluble initiators are best suited. Organic peroxides, like benzoyl peroxide, other acyl and alkyl peroxides including acetyl benzoyl peroxide, o-chlorobenzoyl peroxide, alkoxy benzoyl peroxides, lauroyl peroxide and dibutyryl and dicaproyl peroxides as well as unsaturated peroxides such as crotonyl peroxide have been used as polymerization initiators (free radical generators):







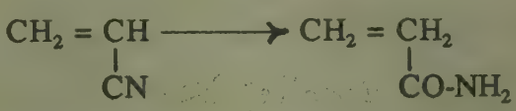




It the dispersion medium is water, ionic catalysts (potassium persulphate) which react with the medium are unsuitable as suspension polymerization initiators. Some suspension stabilizers are inorganic oxides, hydroxides and salts which are not soluble in water, and organic water-soluble polymers like polyvinyl alcohol, methyl cellulose, gelatine, sodium salt of carboxymethyl cellulose (CMC-Na), sodium salt of polyacrylic acid etc. They should be such that they are easily removed from the surface of the bead on which they are deposited, by simple washing.

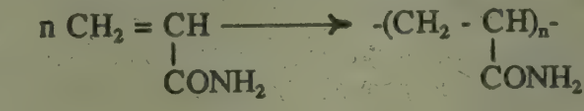
Polyacrylamide

Acrylamide, $CH_2 = CH\text{-}CO\ NH_2$, is made by reacting acrylonitrile with 84.5% sulphuric acid followed by neutralization:



It is available as colourless, odourless crystals with a melting point of 84.5°C. It is soluble in water, alcohol, acetone, butyl cellosolve, dioxane, ethyl acrylate etc. but insoluble in benzene. Acrylamide is toxic by skin absorption and irritant to skin and mucous membrane.

Acrylamide may be polymerized and copolymerized by a variety of techniques, especially solution polymerization using catalysts, light-sensitive dyes and ultrasonic waves. When polymerized (to get homopolymer) in an aqueous medium (at 50°-60°C) in the presence of a small amount of potassium persulphate ($K_2S_2O_8$), polymerization is completed in a short time, with the liberation of a large amount of heat and the solution of the polymer boils.



Acrylamide has been copolymerized with other ethylenic monomers. The degree of water solubility of the final copolymer depends on the acrylamide content of the copolymer. Some of the comonomers are acrolein, acrylates, acrylic acid, acrylonitrile, butadiene, butyl methacrylate, diallyl dicyanide, glycidyl acrylate, maleic anhydride, methacrylamide, methacrylic acid, styrene, vinyl acetate, vinyl chloride, vinyl ethers and ketones, vinyl pyridine and N-vinyl pyrrolidone. Acrylamide homopolymers are nonionic (though some carboxyl groups may be formed through hydrolysis during the manufacture). Copolymers of acrylamide and acidic monomers are anionic in nature.

Polyacrylamide is soluble in water. However, in order to dissolve it, hot water should be taken and stirred (with a high speed stirrer) and the powder added in the vortex, a small amount at a time. The next amount should be added only after

the previous one is completely dissolved. (Polyvinyl alcohol is also dissolved in water in the same way). When the viscosity of the solution increases, further amount of the polymer should be reduced. Some compounds have sufficient solvent action on polyacrylamide to act as plasticizers. These include ethylene glycol, glycerine, dioxolane, lactonitrile, morpholine, propylene glycol and alcohol-ethylene oxide adducts.

Since polyacrylamide is nonionic, the change in solution viscosity with change in pH is not great over the pH range 1-10. When stored above pH 10, the polymer gets hydrolyzed and the viscosity increases rapidly:

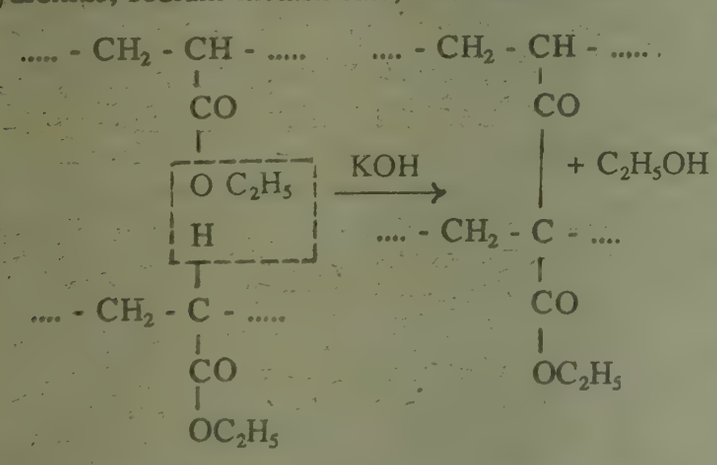
$$-(CH_2\text{-}CH)_n \longrightarrow -(CH_2\text{-}CH)_n \longrightarrow -(CH_2\text{-}CH)_n-$$
$$\quad\quad\quad

from methyl ester. With higher alcohols (propyl, butyl, amyl, etc.) the polymers become softer and tackier at the room temperature, until the polymer from cetyl acrylate, which is hard and wax-like, is reached.

Polymers from acrylates of primary aliphatic alcohols with 4-12 carbon atoms are soft, pliable and have adhesive properties. Polymers made from acrylic esters of alcohols with a ring such as benzyl, cyclohexyl, and phenyl ethyl alcohols are less pliable and adhesive.

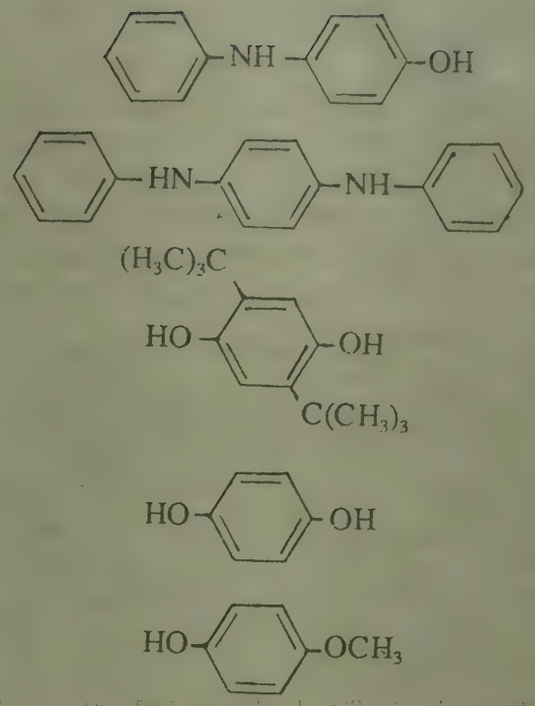
Acrylates produce colourless, transparent polymers, which have, in addition to their tough, rubber-like extensibility, excellent chemical resistance. Their greatest value is as comonomers since the acrylates copolymerize the most readily. Acrylic monomers have been extensively copolymerized with other additive monomers. Improved thermal and photochemical stability and improved mechanical stability of copolymer dispersions produced by emulsion polymerization are the benefits obtained by copolymerization with acrylates. One of the greatest advantages is that of internal plasticization. This is clearly seen in the copolymer of methyl acrylate/butyl acrylate, where both toughness (due to methyl acrylate units) and softness/pliability (due to butyl acrylate units) are simultaneously present. The acrylates (say butyl acrylate) are widely used to internally plasticize polymers made from vinyl chloride, vinylidene chloride, vinyl acetate, acrylonitrile etc.

Homopolymers of ethyl (or methyl) acrylate can be cross-linked in the presence of alkaline reagents like potassium hydroxide, sodium metasilicate, lead oxide etc.



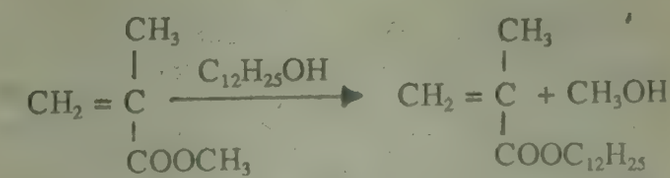
Polymethacrylates

Methyl methacrylate, $CH_2 = C(CH_3)\text{-}COOC_2H_2$, boils at 101°C and has a specific gravity of 0.94. An inhibitor is added to it to prevent polymerization during shipping and storage. Inhibitors used for the purpose include p-hydroxy diphenylamine, N,N'-diphenyl phenylenediamine and 2,5-di-tert.-butyl hydroquinone, hydroquinone, hydroquinone monomethyl ether etc.



Methyl methacrylate polymerizes readily under the influence of heat, light or initiators. Industrially peroxide-type free radical initiators (benzoyl peroxide) are used. Oxygen has a pronounced inhibitory action on the polymerization reaction. Methyl methacrylate is a liquid in which its polymer is soluble.

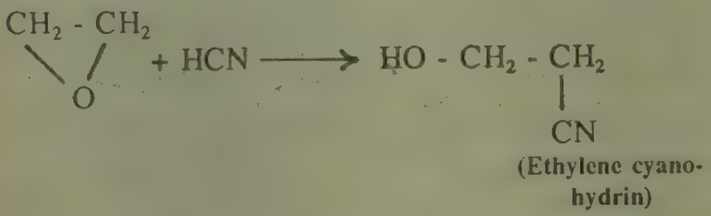
The lower polyalkylmethacrylates are stiffer at room temperature than the corresponding polyacrylates because of the lesser flexibility and mobility of the methacrylate chain, due in part to steric hinderance by the methyl group. Thus polymethylacrylate is a moderately soft polymer, whereas polymethylmethacrylate is the hardest of the common acrylic esters. As with polyacrylates, progressively tackier and softer methacrylic polymers occur as the alcohol portion of the esters becomes larger, until the lauryl ester is reached. Polymers higher than lauryl (in polyacrylates it is cetyl) are wax-like solids at room temperature, having progressively higher softening points. Solubility in oils and hydrocarbons increases with the increase in the size of the alcohol portion of the ester in both polyacrylates and polymethacrylates. The butyl ester is the first in both the series having any appreciable oil solubility. The waxy solids of higher n-alkyl methacrylates are relatively hard, brittle, and opaque, and have sharp melting points. The higher alkyl methacrylates are prepared from methyl methacrylates by ester exchange (alcoholysis) reaction:

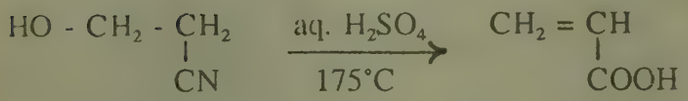


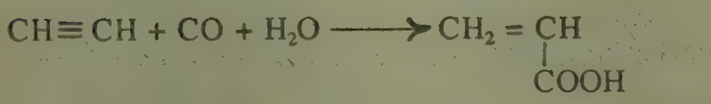
(Methyl methacrylate) (Lauryl methacrylate)

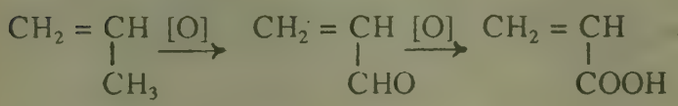
Polyacrylic acid and polymethacrylic acid

Acrylic acid, $CH_2 = CH\text{-}COOH$, also called prepenoic acid and acroleic acid, is made by condensing hydrocyanic acid with ethylene oxide, followed by reaction with sulphuric acid. It is also made from acetylene, carbon monoxide and water in the presence of nickel catalyst. In another method, propylene is oxidized in the vapour state to acrolein, which is then oxidized to acrylic acid at 300°C with molybdenum-vanadium catalyst:

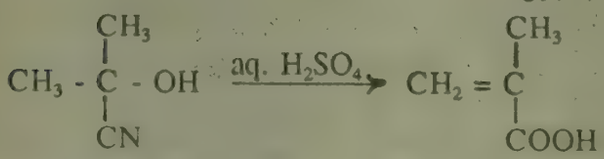


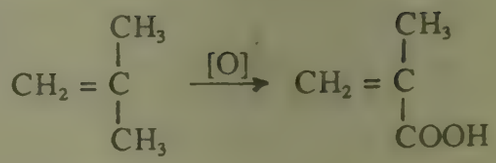






Methacrylic acid, $CH_2 = C(CH_3)\text{-}COOH$, α-methyl acrylic acid, is made by reacting hydrocyanic acid with acetone and then heating with aqueous sulphuric acid at high temperature. It is also made by the oxidation of isobutylene:





(Iso-butylene)

Both acrylic and methacrylic acids are colourless, transparent liquids with an acrid odour. Acrylic acid boils at 142°C and has a density of 1.04 at 25°C, while methacrylic acid boils at 163°C and has a density of 1.01 at 25°C. Both polymerize easily to give polyacrylic and polymethacrylic acids.

In one method of making polyacrylic acid, direct polymerization (by redox initiation) is done by dissolving acrylic acid in water and adding potassium persulphate (polymerization initiator) and sodium thiosulphate (as the activator), at 50-150°C. To regulate the polymer chain length and hence the molecular weight of the polymer, chain transfer systems like secondary alcohols, mercaptosuccinic acid, $HOOC\text{-}CH_2\text{-}CH(SH)\text{-}COOH$, sodium hypophosphite, copper sulphate, etc. are used.

Similar polymers have been prepared in aqueous solutions by exposure to ultra violet light. Very high molecular-weight polymers may be made by this technique.

In a yet another method, polymerization may be carried out with benzoyl peroxide as the polymerization initiator, and filtering the polymer thus formed.

Polyacrylic acids are available in three forms — polyacrylic acids, sodium or ammonium salts of polyacrylic acids, and acidic emulsions that solubilize and thicken under alkaline conditions. These differ in molecular weight and hence in viscosity of their aqueous solutions. Some properties of a few water-soluble acrylic polymers of Rohm & Haas are given in Table 4.

Unlike polyacrylates, the acids of high molecular weight are ionizable and in neutralized aqueous solution behave like

Table 4
SOME PROPERTIES OF WATER-SOLUBLE ACRYLIC POLYMERS

Trade Name	Description	pH	Solids Content, %	Mol. Wt. '000	Viscosity, cP at solids 5%	12.5%	25%
Acrysol A-1	Polyacrylic acid	2	25	50	15	-	320
Acrysol A-3	Polyacrylic acid	2	25	150	18	-	3,000
Acrysol A-5	Polyacrylic acid	2	25	300	20	-	18,000
Acrysol G-110	Ammonium Polyacrylate	9	22	Intermediate	200	-	10,000 (22%)
Acrysol GS	Sodium polyacrylate	9	12.5	High	1,150	15,000	-
Acrysol ASE-60	Polyacrylic acid emulsion	3.5	28	Very High	25,000*	-	-

* When solubilized with NaOH

proteins, as heteropolar colloids. Homopolymers of acrylic and methacrylic acids and their alkali salts are not suitable as plastics, fibres or films because of their water sensitivity. They are brittle when dry and remain hard when heated. At higher temperatures they crosslink and finally char without depolymerization.

Water soluble salts (sodium and ammonium) of polyacrylic and polymethacrylic acids and their copolymers can be used as printing thickeners, stiffeners for fabrics, protective colloids and emulsifying agents, as well as leather finishes. Water soluble polymers (acids, salts and amides) are used as acrylic sizes for synthetic fibre warp yarns.

The alkali salts form viscous solutions in water. Sodium polyacrylate is compatible with most anionic and nonionic dispersions and is unaffected by bacterial or hydrolytic degradation.

Polyvinyl acetate

Vinyl acetate, $CH_2 = CHOOC\text{-}CH_3$, is made by reacting acetic acid with acetylene when ethylidene acetate is also formed:

$$CH_3\text{-}COOH + CH \equiv CH \longrightarrow CH_2 = CH\text{-}OOC\text{-}CH_3$$

$$2CH_3\text{-}COOH + CH \equiv CH \longrightarrow CH_3\text{-}CH\ (OOC.CH_3)_2$$

By passing acetylene rapidly through a suspension of mercuric sulphate in acetic acid at 70°-90°C, and removing vinyl acetate rapidly, the yield of ethylidene diacetate is reduced. The yield of vinyl acetate can be improved in the liquid phase process using lower temperatures and special catalysts. High yields of vinyl acetate may be obtained by using either mercuric phosphate or acetyl sulphuric acid ($CH_3COO\text{-}SO_3H$) and mercuric oxide. Acetylene is passed through the suspension at 35°-50°C at such a rapid rate that most of the vinyl acetate formed is carried out of the suspension by the excess acetylene. With proper control of temperature catalyst and acetylene circulation rate, yields of 80-90% can be obtained.

In another method, a mixture of acetic acid vapour and excess of acetylene at 175°-200°C is passed over a zinc acetate catalyst deposited on activated charcoal. Vinyl acetate is separated from the unreacted acetic acid by fractionation. In this process, small amounts of byproducts, ethylidene diacetate and acetaldehyde are formed.

Vinyl acetate is a colourless liquid with a boiling point of 72°C. It is insoluble in water, but soluble in most organic solvents, including chlorinated hydrocarbons. In the absence of initiators, the monomer is stable at the room temperature. However, it is usually stabilized by adding about 20 ppm hydroquinone. Copper salts, sulphur, diphenylamine may also be used for the purpose. Vinyl acetate is easily hydrolysed under acidic or alkaline conditions. When acetic acid and acetaldehyde is formed:

$$CH_2 = \underset{\underset{COOCH_3}{|}}{CH} \xrightarrow[(H_2SO_4)]{H_2O} CH_3\text{ - }COOH + CH_3\text{ - }CHO$$

$$CH_2 = \underset{\underset{COOCH_3}{|}}{CH} \xrightarrow[(NaOH)]{H_2O} CH_3\text{ - }COONa + CH_3\text{ - }CHO$$

Under alkaline conditions, extremely unstable vinyl alcohol is formed, which rearranges to acetaldehyde:

$$CH_2 = \underset{\underset{OOC\text{-}CH_3}{|}}{CH} \xrightarrow[(NaOH)]{(H_3O)} [CH_2 = \underset{\underset{OH}{|}}{CH}] + CH_3COONa$$

$$\downarrow$$

$$CH_3\text{-}CHO$$

Polyvinyl acetate is produced in the form of aqueous dispersions (wrongly called emulsions). By using redox system of activation, vinyl acetate emulsions can be polymerized at low temperatures, thus minimizing hydrolysis. The dispersions are stabilized by adding small amounts of polyvinyl alcohol.

In one method (emulsion polymerization), a solution of 52 kg. of polyvinyl alcohol in 1000 kg. of water is heated to 85°-95°C and pumped to a jacketed enamelled reaction kettle. To this 1.5-2.5 kg. formic acid and 3 kg. hydrogen peroxide (40 vol) were added. Then 100 kg. vinyl acetate is charged in 5-10 min. The addition is so regulated that the foaming is controlled. When the temperature drops to 72°C, additional vinyl acetate (950 kg.) is added over 1½-2 hours, giving a final temperature of 85°C. No heating is done during polymerization. After the addition of the monomer is completed, the temperature of the reaction mixture is raised to 95°C by circulating water and steam in the jacket. The residual monomer (1-1.5%) is removed under vacuum in 1 hour (the final monomer content in the emulsion is less than 0.5%). The charge is cooled to 50°C and transferred to a mixing and adjusting vessel. Several batches are mixed in this vessel. The viscosity is adjusted by adding small amounts of water. Plasticizers (diethyl phthalate, di-octyl phthalate etc.) are also added at this stage.

Pigment printing binders

Coloured pigments (as well as titanium dioxide) can be fixed onto the fibre surface though they are not bound to the fibre substance either by covalent bonds or by any other bonds normally present between dyes and fibre substances like ionic bond, hydrogen bond, van der Waals forces etc. This is

achieved in pigment printing and dyeing by using suitable binders, which form transparent, soft, pliable films, which trap the pigment particles between the film and the fabric surface and react with the fibre surface. In the earlier attempts, polyvinyl acetate was considered a good binder. However it was found that it produced a stiff handle (in fact it is used as a stiffening agent in textile finishing). On the other hand acrylic resins like polybutyl acrylate produce soft effects, but the pigments bound with them (trapped with them) were not fast to rubbing as polybutyl acrylate does not react with the fibre substance. An emulsion copolymer of vinyl acetate and butyl acrylate and mixing this with modified urea-formaldehyde pre-condensate provided optimum washing fastness. The copolymer (50% solids) was prepared from 70/30 vinyl acetate/butyl acrylate mixture. Urea-formaldehyde pre-condensate mixed with ethylene glycol was prepared as a 80% solids formulation. The preferred binding agent was a 60/40 mixture of the above emulsion copolymer and the modified urea-formaldehyde pre-condensate. This binder when cured on the fabric along with pigments, in the presence of ammonium sulphocyanide catalyst at 130°-140°C for 2-3 min. produced maximum washing and rubbing fastness. However the printed fabrics had a somewhat stiff handle. The following copolymer compositions have been described in patent literature for use as pigment printing binders.

(1) A copolymer of 50-90% styrene and 10-50% butadiene with ammonium sulphocyanide or other ammonium salt as the curing catalyst.

(2) Polybutyl acrylate condensed with tetramethylene diamine in butanol and treated with acetic acid to get an amine salt, along with a copolymer of methyl methacrylate with less than its weight of vinyl chloride, acrylonitrile or other vinyl monomer produces pigment prints of good fastness to rubbing, washing, perspiration and wet treatments.

(3) Polymer prepared from methyl methacrylate, butadiene, N-vinyl pyrrolidone, and a crosslinking agent like hexahydro-1,3,5-triacryloyl triazine, acrylic acid amide of a polyamine etc.

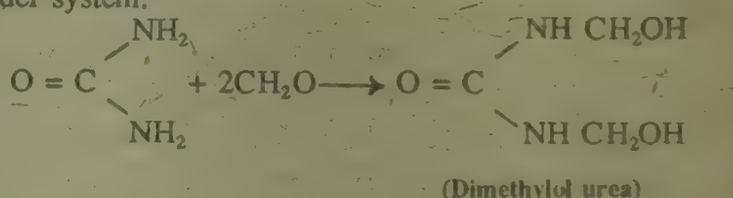
(4) Emulsion of a vinyl or divinyl polymer or copolymer and a high molecular weight basic compound, to be used in pigment printing and treating the printed fabric with a compound containing more than two groups capable of reacting with the high molecular weight compound which may be polyurea, basic polyurethane etc.

(5) Water-insoluble copolymer of a vinyl monomer containing a reactive hydrogen (say acrylamide) and an acrylate or methacrylate of an alcohol with more than three carbon atoms or a butadiene or a chlorobutadiene.

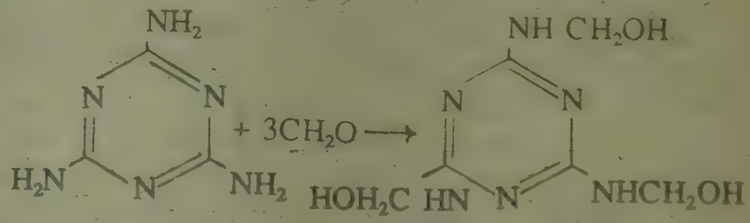
The binders are described as emulsion copolymers of olefinic monomers in an aqueous medium. The monomers are selected from acrylic esters (ethyl, butyl etc.), styrene, acrylonitrile, vinyl chloride, asymmetric dichloroethane, vinyl acetate and diolefins like butadiene. The particle size of the copolymers is in the range 0.5-2μ. High quality binders contain some reactive groups in the copolymer which crosslink the copolymer molecules with each other or with the hydroxy, amino and other groups of textile fibres during curing of the prints. The crosslinking ensures optimum fastness properties (especially washing and rubbing) of the final prints.

The binder must have certain qualities. For example, it should not get coagulated due to shear forces operating during printing. If coagulation takes place clogging of the screens and blocking of the engravings of the printing rollers take place during the actual printing. The binder film must be clear, of even thickness, smooth, neither too hard nor too soft. It should be elastic in nature, and should have good adhesion to the substrate without being tacky. It should have good resistance to chemical and mechanical stresses and the binder should be such that it is easily removed from the engravings of the printing rollers, screens, back greys, blankets.

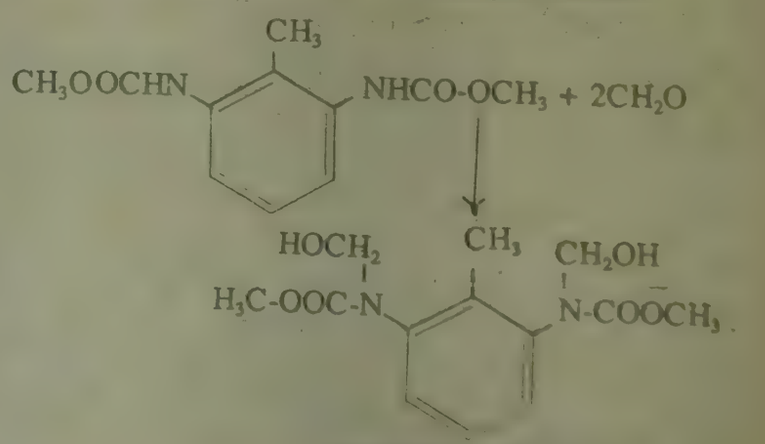
Crosslinking improves the rubbing, washing, and dry cleaning fastness properties, but detrimentally affects the handle of the final print. When the binder molecule has no self-crosslinking groups, an additional crosslinking agent such as urea-formaldehyde pre-condensate or melamine-formaldehyde pre-condensate, methylolated urethane etc. having at least two reactive groups per molecule is incorporated in the binder system:



(Dimethylol urea)



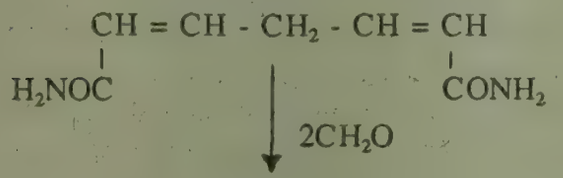
(Melamine) Trimethylol melamine

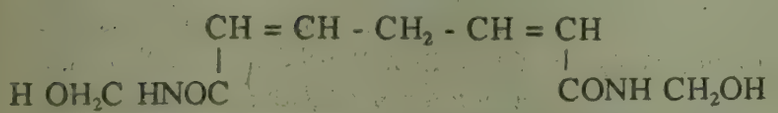


Dimethylolated diurethane

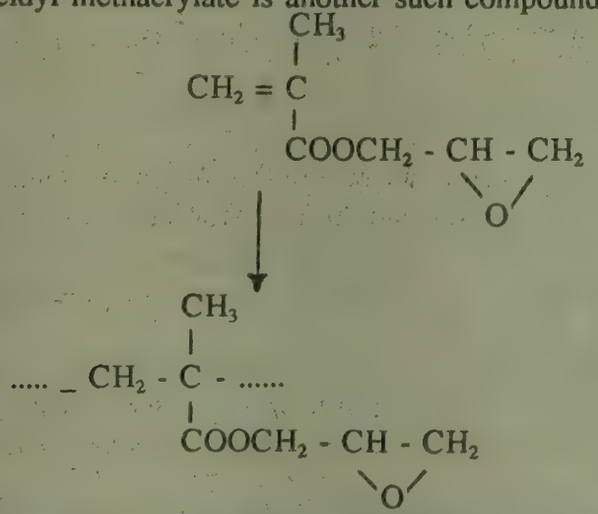
In the case of self-crosslinking binders, small amounts of acrylic or related monomers containing reactive groups are added to the polymerizing mixture. N-methylol group is such a crosslinking reactive group.

Thus methylolated acrylamide or dimethylolated methylene bis-acrylamide may be used for the purpose:



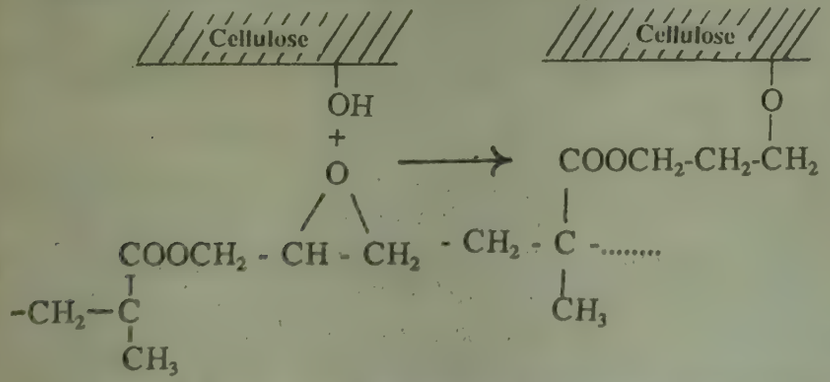


Glycidyl methacrylate is another such compound:



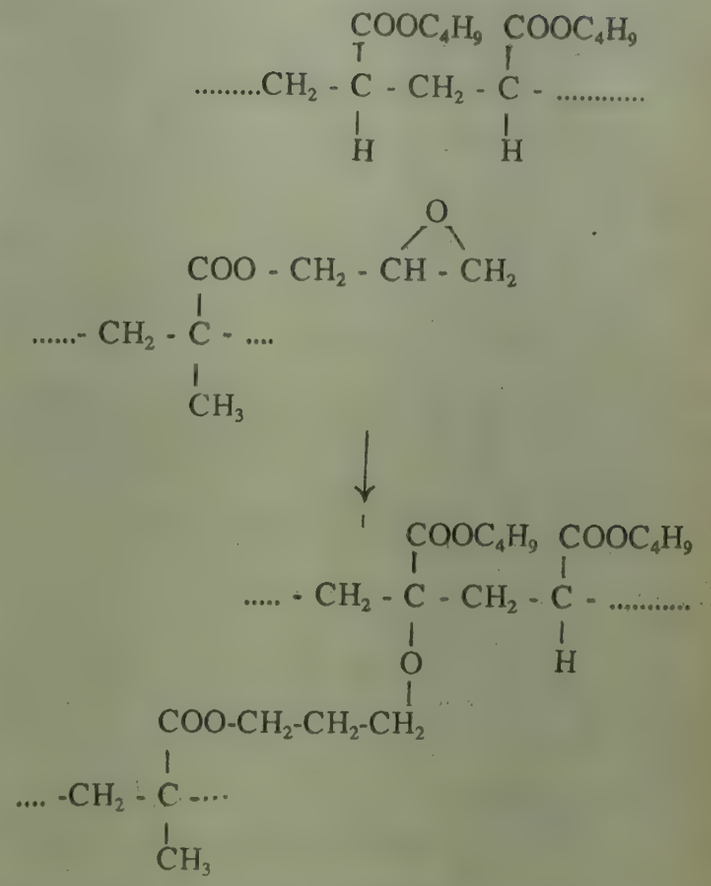
The crosslinking may take place between the epoxy group of one macromolecule and the butyl acrylate portion of another (See Structure G):

The epoxy group of the macromolecule may react with the hydroxy group of cellulose of the cotton fabric:

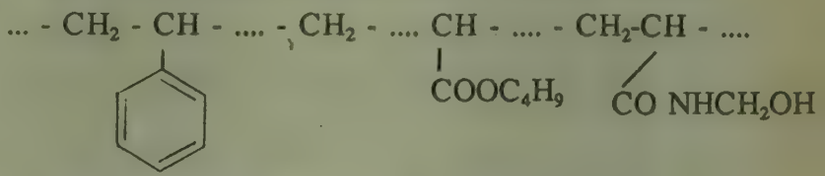


A typical binder may be made by emulsion copolymerizing styrene, butyl acrylate and methylolated acrylamide using nonyl phenol-ethylene oxide condensate as the emulsifier and potassium persulphate/sodium bisulphite as the free radical generating system at about 80°C and finally ter-

Structure G



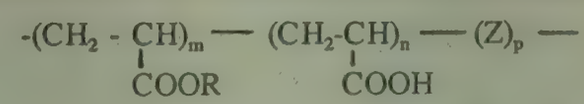
minating the polymerization by adding triethanolamine. A part of the binder macromolecule is shown below:



Soil repellent finishes

Acrylic copolymers and polyacrylates containing fluorinated aliphatic chains are the two main groups of soil repellent finishes. A typical representative of the former group is a copolymer of 70/30 methacrylic acid/ethyl acrylate (prepared by emulsion polymerization in the presence of benzoyl peroxide or di-tert.-butyl peroxide). Excellent soil release effect is obtained when 100% polyester fabric was treated with this copolymer dispersion.

Other acrylic soil release polymers may be represented by



where R is a lower alkyl group like methyl, ethyl etc., Z is a monomeric unit of maleic anhydride, methacrylic acid, acrylamide, acrylonitrile, vinyl acetate, styrene, ethylene, n = 1 or another integer and m and p are zero or integers. Polymers containing large amount of carboxyl groups are soluble in water in their salt forms (hence ease of application) and get crosslinked during curing to give wash fast finishes.

Among the fluorochemicals, polymers of perfluoro-octyl acrylate, made by esterifying acrylic acid with perfluoro-octyl alcohol are very effective soil release agents:

$$CH_2 = CH + HOCH_2\text{-}(CF_2)_6\text{-}CF_3$$
$$\quad\quad\quad

International Market Update

GULF CRISIS SERIOUSLY AFFECTING TANKER AVAILABILITY

Increased demand of petrochemicals from the Far East, has put exporters in the US in a fix. A serious crunch in tanker availability has meant that very many export enquiries have gone abegging. Two factors are causing the crunch: a shortage of oil products, and increased usage of chemical tankers by refineries in the Far East. With many of Far East consumers turning to the West for their supplies, the scenario has pushed freights rates higher by about 20%.

BLAST IN CANADIAN FIRM AFFECTS p-XYLENE

Supplies of p-xylene, particularly to West Europe, has been hit hard following an explosion at a p-xylene producing facility of Kemtec Petrochemicals, in Montreal, Canada. Although nobody was killed in the explosion whch occurred in a furnace in the isomerisation section during start-up, the plant is likely to be out of commission for atleast 3 months.

Spot prices of p-xylene have been rising steadily since the Gulf crisis, and recent heavy purchases by ICI moved prices to around $700/m.t. fob Rotterdam. US prices are in the region of $0.21/lb for fourth quarter deliveries.

TITANIUM DIOXIDE OUTLOOK BETTER

Titanium dioxide producers in Europe and USA expect destocking to be over and better times for them. Prices in North America are holding steady at around $ 1/lb. However long range forecasts are slightly gloomier. Demand at 3.5 million tonnes (end 1995) is expected to be below supply (3.9 million tonnes). However shutdown of a few sulphate-route plants due to environmental considerations could bring a better parity in demand-supply balance, and consequently healthier markets.

JAPANESE MANUFACTURERS HIKE POLYMER PRICES

Following recent announcements of hike in prices of ethylene (25%) and propylene, Japanese polyolefin manufacturers have made predictable moves and hiked prices of PE and PP by an average of 10-12%.

Effective October 21, PE, PP and PVC will be dearer by Y 25/kg. Resistance to the moves is expected from converters many of whom have already had to stomach price increases at Y 10/kg. last March. The Japanese ethylene industry like that in Europe, but unlike the U.S. market, is highly dependent on liquid feedstocks, particularly naphtha. Consequently, upheavals in the oil prices have sent olefin prices soaring. In the U.S. however, much of the petrochemical industry is based on gas, whose prices have remained more stable than prices for oil. Ethylene prices in U.S. have thus been less volatile, with increases in the range of only around 10% being posted. Ethylene producers in Europe are also looking to increase prices of ethylene for fourth quarter deliveries by as much as 30%.

ROSIN PRICES IN USA UP

Low inventories and increasing demand have led tall oil rosin producers in USA to increase prices 3 cts/lb to 22 cts/lb, effective October 1. U.S. tall oil rosin production has been rising steadily and rising inventories had depressed prices, which had reached a high of as much as 45 cts/lb in the mid 1980s. Rosin is a by-product of the pulp and paper industry and their conditions are strongly dependent on conditions prevailing in those markets.

(in millions of lbs/year)

1985	430
1986	434
1987	504
1988.	514
1989	525
1990*	358

* First eight months.

METHANOL PRICES IN US MARKETS UP

Following a fire at Du Pont's 250 million gallon/year unit in Texas, prices of methanol in the U.S. has been steadily firming up, reaching a high of as much as 55 cents a gallon, from levels as low as 40 cents, just a few weeks ago. A strong demand for its primary outlet, MTBE, has also fuelled this rise. Arco has restarted its MTBE plant in Texas and Texas Petrochemicals is also expected to follow suit shortly. Prices in Europe too have recently gone up, with fourth-quarter contracts placed around DM 235/m.t. fob.

MOSMORRAN CRACKER HIT BY ETHANE SHORT SUPPLY

A severe shortage of feedstock ethane, has drastically affected supplies of ethylene and downstream polymers. The Mosmorran, U.K., cracker jointly owned by Shell and Exxon has been reportedly running at a bare-minimum 30% of capacity.

Shells share of ethylene from the cracker is used in the higher olefins and LDPE plants nearby. Although the company has been able to supply higher olefins procured from other sources, it has put its LDPE customers on allocation. The situation is not expected to improve till the end of the year.

DEGRADABLE PLASTICS TO GROW STRONGLY

A recent study by Frost & Sullivan, New York has predicted rapid growth for degradable plastics with markets

doubling in the next five years. 1990 consumption estimated at 1.21 billion lbs is expected to grow to 2.34 million lbs by 1995, with photodegradable plastics increasing their share at the expense of biodegradables. Trash bags now account for the largest demand but good growth is anticipated in grocery bags, agricultural mulch film and loose-fill packaging.

INDUSTRIAL GASES TO COST MORE

The oil crisis and its impact on freight costs has forced AirLiquide, America to levy a surcharge on all delivered products. More such levies are anticipated by the end of the year.

NON-WOVEN FABRICS TO BE PRODUCED IN U.S.

Amoco Nissei Claf Inc. (ANCI), a joint venture between Amoco Fabrics and Fibers of Chicago and Nippon Petrochemicals of Japan, will produce *Claf*, a non-woven fabric said to have outstanding uniformity, strength and tear resistance. The plant to be located in Alabama will produce 200 million sq. yards/year and construction is expected to commence early 1991.

SODIUM AZIDE MARKETS GET A BOOST

The markets for automotive air bags and sodium azide has received a boost, following a recent announcement by the Honda Motor Co. that all of its estimated 700,000 cars to be sold every year from 1993 will be equipped with air bags.

Atleast two U.S. companies have announced capacities for sodium azide, and a race is on to be the first in the market. American Pacific is to build a 1,000—2,000 m.t./year plant and Virtex Oil and Gas has commenced construction of a 1,800 m.t./year plant. Worldwide capacity by 1994 is put at 4,500 m.t. and current trends indicate that the market is likely to be crowded. ICI is already adding capacity and hopes to start supplying 1,250 m.t./year from next year. The Japanese and the Germans also have reasonably challenging capacities, all of which are expected to add up to a hot market place.

A battle of sorts of over the appropriate technology also seems to be taking place with advantages of a cleaner sodium-based technology touted as being significant over an environmentally more troublesome hydrazine route.

SWISS CHEMICAL INDUSTRY SLOWS DOWN

Exports of the Swiss chemical industry in the first half of 1990, were up by only 6.1% compared to figures of around 14% in the previous year. While pharmaceutical exports have still continued to grow strong, exports of dyes, pigments and plant protection chemials have dropped significantly. Outlook for the remaining part of the year is also not very promising, largely due to a strong Swiss Franc and little growth in most outlets like construction, automotive and textiles.

PROBE PREDICTS OCTANE GLUT IN NINETIES

Passage of the Clean Air Act will create an octane glut in the Nineties, according to "The Effects of Reformulated Gasoline on Basic Petrochemicals and Feedstocks," a new study by Probe Economics, Inc. (Millwood, NY).

"Instead of chasing octane," says Probe Senior Consultant John E. Johnson, "refiners will be chasing feestocks to make oxygenates for use in cleaner-burning gasolines."

Although many refiners plan to rely on MTBE, an environmentally sound, high-octane oxygenate, Probe believes feedstock shortages will force them to draw from a wider palette of oxygenates, including ethanol, TAME, and even neat methanol. The shifting feedstock picture will also make wider use of two other additives, ETBE and propylene alkylate, unlikely.

Effects could be worse

"Should Clean Air Act provisions covering oxygen content be extended beyond the presently proposed highly polluted regions in the U.S., or should other nations adopt similar legislation, demand for oxygenates will dry up the world's supply of butane and amylenes, require an 85 percent increase in world methanol capacity, and make ethanol commercially viable without government subsidies," says Probe's President, Fred Peterson.

"It also will depress propylene and polypropylene prices while inflating the cost of ethylene, polyethylene, PVC, and EO/EG," says Peterson.

Probe's forecasts are based on a complex, proprietary model of worldwide economic, energy, and chemical interactions. "Using the model keeps us honest," says Peterson. "It not only captures many subtle interactions between different sectors of the chemical and refining industries, but also ensures that we use the same starting assumptions for all forecasts."

If the most stringent conditions now proposed for the Clean Air Act are approved, gasoline refiners will have to halve concentrations of potentially carcinogenic benzene and eliminate n-butane to reduce gasoline volatility. Both benzene and n-butane are important octane enhancers.

Oxygen the key

The Act would also require refiners to add more than 2.7 wt. % oxygen to reduce NOx emissions in the nine "non-attainment areas" that cannot now meet current pollution standards. "Conventional wisdom has held that refiners will spend the Nineties looking

for new sources of octane, such as propylene alkylate, to replace lost benzene and butane," says Johnson.

Johnson believes refiners will be beset by too much octane during the Nineties. "MTBE, neat ethanol, and to a lesser extent, neat methanol, will be used to meet mandated oxygen requirements, and all of them have high octane values. Their use will not only make new propylene alkylate capacity superfluous, but actually cause refiners to cut reduce reforming operations, a major source of aromatics".

Wide oxygen use required

Probe's analysis shows that roughly 40 percent of the nation's gasoline will be oxygenated if the Clean Air Act is passed. The nine "non-attainment areas,' which include the Boston-Washington and Los Angeles-San Diego corridors, account for 25 per cent of domestic gasoline consumtpion. Yet the gasoline distribution system is not flexible enough to limit oxygenated gasoline to just these districts without also selling it in surrounding suburbs. Probe also expects some cities to mandate oxygenates independently of the Federal Government, as Denver and Phoenix have already done.

The U.S. refining and petrochemical industry could oxygenate just under 20 per cent of the domestic gasoline pool, says Johnson, by using all existing MTBE and ethanol capacity and reducing the amount of ethanol that gas must contain to qualify for a subsidy. Achieving nearly 35 percent coverage would require diversion of all C4/C5 olefin feeds for production of MTBE and TAME. If they are to reach the 40 percent level, they will have to catalytically dehydrogenate iso-butane and convert to MTBE, a more expensive process.

"After chasing octane to replace lead all through the Seventies and Eighties, refiners chase feedstocks to make oxygenates during the Nineties," says Johnson. At 40 percent coverage, we will use all domestically available iso-C4/C5 olefins and those isobutanes freed up by reduced alkylate demand, and will require 21 percent more methanol capacity worldwide."

Propylene alkylate, ETBE, out

Butanes, in particular, would become a very valuable component of the refinery stream because they can be upgraded into MTBE. "Even if additional octane were needed in the Nineties," Johnson explains, "few refiners would want to alkylate propylene with iso-butane because that's taking feedstock away from MTBE production. Similarly, rather than react ethanol and iso-butylene to make ETBE, an octane enhancer, refiners would rather add straight ethanol to the gasoline pool and use the iso-butylene to make more oxygenates."

Even at 40 percent coverage, gasoline reformulation will have only a small impact on petrochemical supplies and prices. Aromatics, propylene, and butylene prices will decline slightly and ethylene and LPG prices will rise.

"But should the Federal Government decide to mandate oxygenate use throughout the 50 states, or should other countries adopt oxygen standards for gasoline, we could quickly use up total C4/C5 capacity in the market economies and need to nearly double methanol capacity," warns Johnson.

"At that point," says Johnson, "we could see sharply lower propylene and aromatic prices, and higher ethylene, LPG and isobutylene prices." The study, "The Effects of Reformulated Gasoline on Basic Petrochemicals and Feedstocks," is available from Probe Economics, Millwood Business Center, Route 100, Postal Drawer M, Millwood, New York 10546-0909, USA for $2,500 for the first copy and $100 for each additional copy.

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News About New Projects

EXXON CONFIRMS PLANS FOR SINGAPORE AROMATICS COMPLEX

Exxon Chemical has signed a letter of intent to conduct a feasibility study, alongwith Amoco Chemical, and Taiwan's China American Petroleum Company (CAPCO), for an aromatics complex to be located near Esso's refinery. While product sharing and company holding details have not yet been finalised, CAPCO and Amoco are expected to use bulk of the p-xylene available for PTA production, while Exxon is expected to offer most p-xylene for merchant sale.

The move follows a recent decision of Mobil Chemical, to build a world-scale aromatics complex in Singapore. Shell, which operates Singapore's largest refinery, is also said to be contemplating such a move.

Singapore has picked up a large share of global investments in the Far East. Other projects on the drawing board include Shell's ethyl benzene/styrene facility, Du Ponts' Spandex project and GE venture for engineering plastics.

NESTE EXPANDING POLYESTER BUSINESS

Neste Chemicals (Finland) is rapidly expanding its' polyester resins business by acquiring three companies in France, USA and Taiwan. The deals will make Neste the 8th largest producer of polyester resin and the second largest producer of polyester gelcoats.

The deals will add another 50,000 m.t./year to Nestes current capacity of 20,000 m.t./year. Maleic anhydride and styrene will be continued to be brought in the market although the company has announced some plans to set up a styrene unit.

NEW POLYPROPYLENE PROJECT IN SAUDI

Himont, the worlds largest producer of polypropylene, will team up with a private Saudi group to put up a propane-propylene-polypropylene project in the Yanbu complex in Saudi Arabia. Using feedstock from the Saudi Arabian Marketing and Refinery Co., the company will dehydrogenate propane to produce 300,000 m.t./year of propylene. A part of it (180,000 m.t./year.) will be converted into polypropylene (homo-and co-polymer) using Himont's Spheripol technology and the balance will be marketed. The plant is planned for early 1994, making it, in all probability, the second PP plant in Saudi Arabia. Earlier Neste/Sabic/Ecofuel had announced a 200,000m.t./year PP facility, Ibu Zahr, at Al Jubail using Union Carbides' Unipol process. The complex will use propylene from Petrokenya's (a Sabic subsidiary) cracker coming up at Al Jubail by the end of 1993.

SHELL BRASIL TO BOOST ACARICIDE BUSINESS

In a move to boost its 17% share of the $90 million Brazilian acaricides industry, Shell Brasil (Sao Paulo) has announced plans for a $13 million, 600 m.t./year multi-purpose production facility at Paulina in Sao Paulo.

The main product is expected to be the organo-tin acaricide, *Torque* (Fenbutalin oxide) used in Brazils organge crop, but the plant can also produce other insecticides, herbicides, polyvinyl chloride stabilisers and cement and glass additives. The market for acaricides in Brazil is extremely competitive with almost all world players having a marketing presence. Shell however is the first unit to backward integrate with a production unit. The new plant is also expected to cater to markets in the neighbouring countries as well.

IRAN PLANS FERTILISER COMPLEX

The National Petrochemical Company of Iran is planning a grass-roots gas-based fertiliser complex to be built at the Khorassan province. The plant is to produce 1,000 m.t./day of ammonia and 1,500 m.t./day of urea. The company is seeking buy-back arrangements to pay for the complex, offering various chemicals and petrochemicals in exchange. Companies intending to bid for the project include Nisho Iwwai, Toyo Engineering, M.W. Kellogg, TPL of Italy and Snamprogetti.

POLYPROPYLENE UNIT GOES ON-STREAM IN THAILAND

An 80,000 m.t./year polypropylene plant built by Uhde, using BASF's Novolen gas phase process has gone on-stream recently. The plant, owned by Thai Petrochemical Co. is located in the province of Kayong.

EXXON EXPANDS HALOBUTYL CAPACITY

Exxon Chemical Polymers, has announced expansions of its halobutyl synthetic rubber facilities in the U.K. and Louisiana, USA. The increases will add another 40,000 m.t./year to Exxon's capacity partly through improvements in plant operations and productivity. The company is also constructing a new unit in Kashima, Japan which will add another 15% to its capacity.

PHILLIPS READIES HDPE PLANT

Phillips 66 has completed construction of a the first of its three HDPE plants, at Pasadena, Texas, USA. The plant will produce 300 million lb/year and will be on-stream in another few weeks. Phillips has substantial capacity planned for the future at the same site: a 600 million lb/year plant is scheduled for mid-1991 and a 900 million lb/year unit is planned for mid-1992. The total capacity will then come to 1.8 billion

lbs/year, roughly equal to that existing before a massive explosion wiped out the plant, late 1989.

DAVY TO BUILD MTBE PLANT IN USA

Davy McKee has signed a contract with Coastal Chem to build a 4000 barrel/day MTBE plant in Wyoming, USA. The complex will be the first world-scale project to use Phillips Star technology to manufacture isobutylene. Davy will provide basic design, detailed engineering, procurement, construction, pre-commissioning and start-up assistance.

HOECHST-CELANESE TO UP ACETATE CAPACITY IN CHINA

Hoechst-Celanese will be doubling capacity of cellulose acetate filter tow to 25,000 ton/year and add a similar amount to its capacity of cellulose acetate flakes, in an $100 million expansion program at its Nantong Cellulose Fibers plant in Jiangsu province of China.

AIR PRODUCTS BEGINS PVA PLANT CONSTRUCTION

Air Products has commenced construction of its first plant to make a biodegradable polyvinyl alcohol (PVA), Vinex at Pennsylvania, USA. The resin which degrades in the presence of moisture and the bacteria Pseudomonas boneopolis is expected to find applications as agricultural films, blow-moulded containers for organic liquids and disposable personal-care products. The plant will come on-stream by end of 1991.

PHILLIPS, DU PONT TO SET UP RECYCLING PLANT

Phillips Plastics Recycling Partnership, a joint venture in which Phillips will have a 51% stake will be setting up a $ 3.5 million plant for recycling HDPE. The plant is expected to be completed by 1991. In a related development, Du Pont will team up with American National Can be set up a PET/HDPE recycling project. The project will handle rigid plastic bottles, including multilayered bottles and other plastic materials not being widely recycled at the momement.

TECHNOLOGIES FOR TOBOLSK CRACKER FINALISED

The West Siberian Petrochemical Company, the first East-West giant petrochemical project has finalised technologies for the $2.2 billion project to be located at Tobolsk, Siberia.

Propane dehydrogenation:
Technology: Houdry
Product: 457,000 Propylene

Propylene polymerisation:
Technolpgy: Himont-Spheripol
Product: 450,000 PP

SBR manufacture:
Technology: Fina
Product: 30,000 SBR

The first phase having a 225,000 m.t./year PP (homopolymer) facility will be ready by 1995, and the second train will go on stream a year later producing on equivalent amount of co-polymer material.

FRENCH CITRIC ACID CAPACITY TO EXPAND

The Vienna (Austria) based citric acid giant, Jungbunzlauers, with a world-wide share of around 20% is planning a major investment in France. The company has announced plans for a 40,000 m.t./year plant as part of a world-wide expansion program. The company has presently two plants: one in Germany (30,000 m.t./yr) and one in Austria (90,000 m.t./year, being increased to 80,000 m.t./year).

The company sees good prospects in the long run particularly for the production of sodium citrate for use in detergents. Bayer is another company with a global presence and holds some 30% of the global 500,000 m.t./year market.

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News From Japan

BENZOYL PEROXIDE MAKERS' GROUP TO WORK OUT SAFETY GUIDELINE

Following the disaster caused by the recent explosion of a benzoyl peroxide (BPO) plant at the Tokyo factory of Dai-ichi Chemical Industries, Ltd., a Japanese BPO makers' association has revealed measures to be taken to prevent such accidents and enable the continuation of stable supplies of BPO to users.

The explosion occurred on May 26 at Dai-ichi Chemical's plant for dry-type (100%-pure) BPO — an explosive and hazardous substance —causing great criticism and concern over its production, particularly because the plant was located in a metropolitan area. The 100%-pure BPO was used as a polymerization initiator (catalyst) and produced only by Dai-ichi Chemical. As a result of the accident, the company has given up production of the dry-type BPO.

Japan Organic Peroxides Manufacturers' Association has decided to immediately start a committee within itself comprising 18 representatives, two each from its nine member companies, so that it can work out a voluntary guideline for safe operations of BPO and other dangerous organic peroxides, seeking the guidance of the Ministry of International Trade and Industry and the Fire Defense. In line with this, the committee will also compile another guideline for users of such chemicals with regard to their use, preservation and storage, as a first step.

The guideline for BPO makers will be finalized within a year. As for BPO supplies to users, four existing makers, including Nippon Oil & Fats Co., have agreed to expand production of both 75% wet-type and 50%-paste-type BPO to compensate for the reduced production caused by the operation stop of Dai-ichi Chemical's plant. In addition, the association will propose substitutes for 100%-pure BPO which will no longer be available here.

Candidates as substitutes will be wet-type and paste-type BPO, modified BPO mixed with powdered plasticizers and tert. butyloxy-octanoate.

MITI AGENCY PLANS TO LAUNCH PETROLEUM ENERGY RESEARCH LAB

Agency of National Resources and Energy attached to the Ministry of International Trade and Industry is planning to set up a research institute for petroleum energy engineering as the second project for Petroleum Energy Centre (PEC).

If the project is implemented, it will be the agency's nucleus project starting in fiscal 1991 which begins next April.

The research organization is aimed at pushing development of systems enablin supply and utilization of petroleum energy in an efficient way and in a clean form, by seeking co-operation of private businesses.

PEC has so far been tackling energy R&D tasks separately with private companies but recognizes that the petroleum industry is now confronted with vital issues, like global environmental destruction, that can never be solved merely by the efforts of separate businesses but should be coped with, through concerted actions.

The common research themes that may be tackled will be related to next-generation superclean fuel, a highly efficient amenity energy system, material for a ceramic gas turbine and lubricants, etc.

The agency will ask for a ¥4.9 billion budget for the first year to launch the project.

MITSUBISHI GAS CHEMICAL TO ADD COPPER-CLAD GLASS-EPOXY LAMINATES

Mitsubishi Gas Chemical Co. is implementing a plan for building a new plant for copper-clad glass-epoxy laminates in Shirakawa, Fukushima Prefecture by the end of next year. The labor-efficient plant will be operated by staff members numbering only one third those employed for the company's Tokyo factory.

The firm aims to attain annual sales of ¥50 billion for electronics products including copper-clad laminates and printed circuit boards as mainstay items. The new plant will help hit the sales target. The Tokyo factory is the company's largest production base for copper-clad glass-epoxy laminates, semi-finished laminates and laminate material.

It has, however, no room for building a new plant therein. The production capacity of the planned plant will be half that of the Tokyo factory. The company established Dia Denshi Co. last year in a bid to integrate the Mitsubishi Gas group's production of circuit boards and commercialize fine-pattern ones.

KUREHA CHEMICAL BRANCHES OUT INTO PLASTIC EYEGLASS LENS BUSSINESS

Kureha Chemical Industry Co. has established Kureha Lentech Co. with the aim of diversifying into plastic-lens operations. The new subsidiary is scheduled to build a new plant for producing 1.5 million pieces a year of eyeglass lenses at Kureha Chemical's Nishiki factory in Fukushima Prefecture: the plant will be completed next summer.

Kureha Chemical has already pioneered a plastic lens using new material having a triazine ring. The product has a high refractive index (1.55) and a large Abbe number and is endowed with the

optical/mechanical properties required of eyeglass lenses: they include low specific gravity and high strength. It is forecast that eyeglass-lens business will continue to show steady growth in Japan along with the graying of society and qualitative improvement of people's lives. Kureha Chemical envisages finding new outlets for plastic lenses in optical equipment in addition to the eyeglass-lens outlet.

The company is striving to develop new business fields since "Krestin" anticancer agent — the company's major profit earner — is now making a smaller contribution to its business performance in the wake of reduction of the official price for the product itself, commercialization of rival drugs and compulsory re-examination of the products efficacy.

In a related development, it has commercialized carbon fiber-reinforced concrete panels in a team-up with the Kajima group.

MITSUI TOATSU, NIHON OXIRANE GIVE UP PLAN FOR SIMULTANEOUS PO/SM PRODUCTION

Mitsui Toatsu Chemicals has given up its plan to build a plant for simultaneous production of propylene oxide (PO) and styrene monomer (SM), whose production is being carried on by Arco Chemical of the United States, and has decided to expand the production of PO and SM independently by the existing processes.

In accordance with this decision, Nihon Oxirane (joint enterprise of Sumitomo Chemical, Arco Chemical Company, and Showa Denko), too, has consolidated its intention to expand production facilities independently by debottlenecking. Mitsui Toatsu Chemicals and Nihon Oxirane have been planning to build facilities for annual production of 250,000 tons of SM and 100,000 tons of PO inside the Osaka Plant of Mitsui Toatsu Chemicals.

The implementation of this plan has been dependent only on the final conclusion to be reached by Mitsui Toatsu Chemicals.

The latter has decided that the existing processes are superior and has given up the plan for joint production, because the construction expenses involved are likely to increase beyond the level of the original plan and amount to more than ¥40 billion, because the successive working out of plans for expansion of SM production facilities is likely to lead to oversupply, and because of the balance between the cost of PO and that of chlorine. As a result of this decision, the two companies will push their plans for the expansion of PO and SM production independently, although they will continue to offer PO and SM to each other.

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New Developments From Japan

NEW BIOCATALYST TO HELP TRIPLE ACRYLAMIDE PRODUCTION

Nitto Chemical Industry Co. intends to more than triple acrylamide production to 20,000 tons a year next spring at its Yokohama factory since it has gained confidence with regard to commercial use of a 3rd-generation biocatalyst called Rhodococcus rhodochrous J1. On completion of the project, the company's biological process will be almost equivalent to the conventional copper-catalyst process used for domestic acrylamide production.

Nitto Chemical is Japan's only acrylamide producer employing the biological process. The company previously built a 4,000-t/y plant using Rhodococcus rhodochrous SP 774 (1st generation) as a biocatalyst and scaled up the production capacity to 6,000 tons a year employing Pseudomonas chlororaphis B23 (2nd generation).

The 3rd-generation biocatalyst's production capacity for acrylamide is 10 times that of the 2nd-generation biocatalyst. Since it has strong resistance against amide, the product calls for no concentration process and facilitates production of high-concentration acrylamide solution. In addition, it enables production of high purity products by capitalizing on its own reaction selectivity.

The planned production expansion will boost the company's acrylamide production by roughly ¥5,000 million. It will cost ¥200-300 million to increase the capacity of storage tanks and enlarge the diameter of transportation pipes for raw material and products.

EFFICIENT HEPATITIS-A VACCINE TO BE AVAILABLE IN FEW YEARS

An efficient hepatitis-A vaccine is likely to become commercially available through joint efforts by Denkaseiken Co., Chiba Serum Institute and The Chemo-Sero-Therapeutic Research Institute. The vaccine first developed by National Institute of Health (NIH) attached to the Ministry of Health and Welfare has gone through phase-II clinical tests and has proved very efficient compared with immunoglobulin preparations which have so far been used as hepatitis-A vaccine.

Denka and the two research institutes have been tackling clinical development of the new vaccine and, as a result of the successful clinical testing, will undertake clinical tests on a large scale and finish them by the end of next year to prepare for applying for manufacturing approval in 1992. It will be the first such application in Japan.

The vaccine was originally produced by NIH by making inactive the virus collected from faeces of patients afflicted with hepatitis A. The vaccine has proved to be effective for 4-5 years and far more effective with far less dosage than in the case of using conventional immunoglobulin preparations.

Tests conducted at the hospital attached to Kumamoto Unviersity showed that the serum anti-HAV of the new vaccine recorded 1,170 units in the 28th week after its administration with a dosage of 0.25 microgram, whereas an immunoglobulin preparation administered in a dosage 7.5 milligrams per kg of the weight of a patient showed 85 milliunits in the fourth day after administration.

Researchers at Kumamoto University suggest that three administrations of the new vaccine in a certain period would be most effective.

The hepatitis-A vaccine will be used mostly for young Japanese without anti-HAV serum, particularly those in and below their thirties.

AUTOMATIC CELL-FUSION SYSTEM USING RECTANGULAR PULSE BARED

Shimadzu Corp., has developed and begun marketing a computer-aided cell-fusion system dubbed "SSH-10" operated by means of the control of appied rectangular-pulse voltage. It is claimed to enable automatic fusion of animal and plant cells as well as the cells of microorganisms whose mechanical manipulation has been considered difficult.

By setting in advance the 14 conditions necessary for cell fusion, including rectangular-pulse voltage and the time of voltage application, the new system automatically handles, by key operation, the materials that have been charged therein.

The method of applying rectangular-pulse voltage to carry out cell fusion is absorbing industrial attention because it is more than 10 times as efficient as conventional methods using fusion stimulators such as polyethylene glycol. SSH-10 is said to be the most advanced type of this kind.

It can store 100 kinds of fusion programs which can be called up just by designating the corresponding file numbers. It is also equipped with a data base in which the conditions for every cell fusion and starting such fusion have been recorded so that the optimum condition can be accessed at any time.

SELF-DOPED CONDUCTIVE POLYMER CHEMICALLY POLYMERIZED: SHODEN

Showa Denko K.K. (Shoden) has succeeded in synthesizing self-doped conductive polymer using a chemical-polymerization process for the first time in the world. The polymer has hitherto been produced by means of an electrolytic-polymerization process

The company employed 3-(3-thienyl) propane sodium sulfonate as starting material and chemically polymerized it within aqueous solution with the help of ferric chloride (oxidant), thereby obtaining black-colored insoluble poly 3-(3-ferrous thionyl) propane sulfonate.

It changed the resultant product into aqueous solution of red-colored sodium salt-type conductive polymer by treating it with aqueous solution of sodium hydroxide.

The aqueous solution can easily be changed into acid conductive polymer or alkaline metal salt after passing through H-shaped ion exchange resin.

The conductive polymer thereby synthesized contains sulfonic acid, which is linked with the polymer's main chain and acts as a dopant. Like other types of conductive polymer, the new polymer also has the π-electron conjugated system.

The product's electrical conductivity stands at 0.05S/cm. Its molecular weight is as heavy as 100,000 on average since the chemical-polymerization process has been employed.

The polymer can be transformed into dark green highly conductive film using a casting process.

Conductive polymer synthesized using an electrochemical process only has low molecular weight and a low degree of polymerization. Its production is based on the batch system, while the new polymer can be produced continuously on a commercial basis.

HIGH-PURITY ZIRCON POWDER PRODUCED USING SOL-GEL PROCESS

Tosoh Corp. has succeeded in synthesizing high-purity zircon powder using a unique sol-gel process. It contains no impurities (nickel oxide and titanium dioxide, etc) since nothing but seed crystal of natural zircon is added to the zirconium oxide and silica both employed as raw materials.

The bending strength of the sinter produced from the powder stands at 320 megapascals at a temperature of 1,400°C roughly 30 times that of natural-zircon-based sinters.

The company envisages establishing the new process on a commercial basis within a year and applying the new product to high-temperature jigs, material for high-temperature electric furnaces and semiconductor substrates.

In conventional methods, zircon powder is produced by refining natural zircon or making zirconium oxide and silica react with each other.

The bending strength of the sinter produced from natural-zircon-source zircon powder markedly wanes at a temperature of more than 1,000°C since it is not sufficiently compact.

When zirconium oxide is reacted with silica, nickel oxide, titanium dioxide and copper oxide are added thereto to promote the reaction process.

The additives remain in the sinter in the form of impurities, thus reducing the sinter's bending strength at temperature of above 1,400°C.

The particle size of the new product is between 0.2 and 0.3 micron. Physical properties of the sinter produced therefrom are: bulk density; 4.65 g/cm^3, Vickers hardness; 14 gigapascals; bending strength; 320 megapascals between 20 and 1,400°C and coefficient thermal expansion; 4 x 10^{-6} (1,300°C).

GRAPHITE DIRECTLY TRANSFORMED INTO BETA-SILICON CARBIDE

Toyo Tanso Co. has established technology for transforming graphite material into ultrahigh-purity Beta-silicon carbide, which the company intends to apply to jigs for a silicon carbide-based on diffusion furnace.

Employing the new process, the company controlled the particle size of the graphite material, formed micropores on the surface and inside isotropic graphite produced from the graphite particles and changed the resultant product into Beta-silicon carbide at high temperature.

The product is impregnated with silicon or coated with silicon using a CVD process.

The two types of products have high thermal conductivity and the CVD-type one in particular has strong acid/corrosion resistance.

Their basic properties are: bulk specific gravity; 3.0; bending strength; 220 megapascals; thermal conductivity; 48 1,000 K) W/m K; Vicers hardness; 2,600 Hv (100) and impurities — iron, 1.9 ppm; nickel, 0.4 ppm and chromium 0.009 ppm.

Their prices are almost equal to those of conventional-type products. The company has established technology for forming flat CVD film on the uneven surfaces of target material.

It facilitates production of jigs of complicated shape.

Baking temperature within a diffusion furnace designed to form oxide film upon silicon wafers is going to reach 1,300°C along with the increase in the diameter of silicon wafers.

In a related development, raw material for the furnace is being switched from quartz to silicon carbide.

Conventional-type silicon carbide, however, contains sintering auxiliaries as impurities and its workability and dimensional stability have not reached a satisfactory level.

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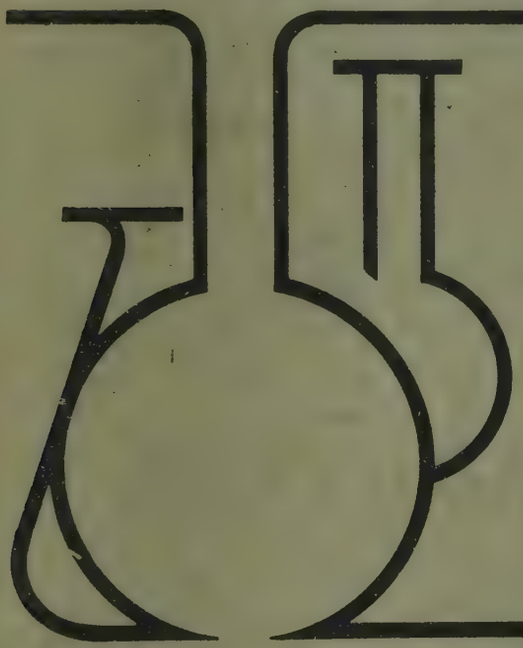

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CHLOROPHENIRAMINE MALEATE I.P.
CHLORAMPHENICOL PALMITATE I.P.

DRUG INTERMEDIATES

N-CHLOROSUCCINIMIDE
N-BROMOSUCCINIMIDE
NITROMETHANE
2,6-DICHLOROANILINE/PHTHALIMIDE
o-NITROBENZYL BROMIDE
N-METHYL CYCLOHEXYLAMINE
BIS-TRIMETHYLSILYL UREA

Contact Manufacturers:

Box No. 1289
CHEMICAL WEEKLY
306, Shri Hanuman Industrial Estate,
G.D. Ambekar Road, Wadala, Bombay-400 031

Telephone:
Office: (022) - 251793
(022) - 298453
Resi: (022) - 6482147

DI BUTYL PHTHALATE DI BUTYL MALEATE
DI OCTYL PHTHALATE DI OCTYL MALEATE

Contact Manufacturers:

DILIP CHEMICALS
(Prop. TARAPORE FINE CHEMICALS PVT. LTD.)

Office: 509, Apeejay House, 130, Bombay Samachar Marg, Bombay 400 023.
Gram: TARAKEMCOM Tel: 244253
Factory: C-1-B, Type Shed No. 43, Near GIDC Post Office, Vapi 396 195.
Gram: FINECHEM Tel: 622

MARKET INFORMATION

Chemicals Sluggish

Sluggish demand with slight increase in prices marked the trend in the Bombay chemicals market during the week under review. Traders are complaining of money crisis, and attributed the slump in demand due to political uncertainty. The dyes intermediates section was better.

We cannot guarantee the accuracy of the prices published in CHEMICAL WEEKLY as they are based only on the enquiries made by our correspondent -- and, as such they are not FIRM PRICES as between a buyer and seller. The prices are published only with a view to giving some ideas of the market conditions.

The prices are inclusive of Excise and Maharashtra Sales Tax.

(Prices as on November 14, 1990)

INDUSTRIAL CHEMICALS	Per Kg.
Ammonium sulphate	2.50
Ammonium phosphate (Mono)	16.00
Ammonium phosphate (Di)	16.00
Ammonium carbonate (Di)	17.00
Ammonium bicarbonate	6.00
Ammonium chloride	4.00
Ammonium nitrate	6.50
Arsenic white powder	22+ST
Acrylamide (Resale)	82.00
Barium carbonate	18.00
Bleaching powder (33% Cl)	5.00
Borax (Granular)	17.00
Borax (Powder)	24.00
Boric acid (Tech)	45.00
Bisphenol-A	75.00
Butyl carbitol	106.00
Caustic soda (Flakes)	11.50
Caustic soda (Solid)	12.00
Caustic soda (Lye)	10.00
Calcium chloride 70% (Solid)	3.25
Calcium chloride 75-80%(fused)	3.50
Calcium chloride 36% (Anhydrous)	5.00
Calcium carbonate (precipitated)	6.00
Calcium carbonate (Activated)	5.75
Cobalt oxide	550.00
Cresylic acid	62.00
Camphor (Indian)	104.00
Cream of Tartar (Tech.) China	70.00
Citric acid (Belgium) (Resale)	47.00
Citric acid (Indian) (Resale)	44.00
Copper sulphate	25.00
Chromic acid	70.00
Ethylene urea	65.00
Ferric chloride (Lumps)	9.00
Ferric chloride (Anhydrous)	20.00
Glue flakes	15.00
Glue sheets	6.75
Gohsenol GH-17	135.00
Hydro	45.00

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ORTHO CHLORO PHENOL
MONO CHLORO PHENOL
DICHLORO PHENE
SULFURYL CHLORIDE
E.D.T.A.
MONO CHLORO ACETIC ACID (MCA)
ISOPROPYL BROMIDE
CAUSTIC POTASH FLAKES
POTASSIUM CARBONATE
NORMAL BUTYL BROMIDE (NBBR)

Authorised Dealer of

M/s. Standard Alkali,
M/s. Anupam Rasayan,
M/s. Odex Chemicals Pvt. Ltd.,
M/s. P.K. Velu & Co. Pvt. Ltd.,

Please Contact:

Shree Amruta Organics Pvt. Ltd.

813, Raheja Centre, 214, Nariman Point, Bombay 400 021.
Phone: 240415, 243979, 2873680 Telex: 11 6053 SATC
4A-B, Trade Centre, Near Stadium House,
Ahmedabad 380 014.
Telephone: 462332

Hyflosupercell	29.00
Hexamine (Resale)	37.00
Industrial Wax	25.00
Litharge	40.00
Lead Acetate (Tech.)	39.00
Lithopone	34.00
Magnesium chloride (Crystal)	2.75
Menthol crystal (Flakes)	360+Ex+ST
Menthol bold	425+Ex+ST
Menthol crystal cold	395+Ex+ST
Magnesium carbonate (Japan)	30.00
Magnesium carbonate (Indian)	26.00
Maleic Anhydride (Resale)	45.00
Mercury (34.5 Kgs)	11,000.00
Nickel chloride	110.00
Oxalic acid (Resale)	14.00
Peppermint oil (Rectified)	188+Ex+ST
Potassium carbonate (Indian)	28.00
Potassium carbonate (Imported)	32.00
Potassium bichromate	42.00
Potassium phosphate (Mono)	34.00
Potassium phosphate (Di)	25.00
Polyvinyl alcohol (No. 117)	93.00
Polyvinyl alcohol (No. 173)	150.00
Polyvinyl alcohol (No. 208)	170.00
Paraformaldehyde (Resale)	22.50
Phthalic anhydride (Resale)	55.00
Pentaerythritol (Resale)	52.00
Paraffin wax	25+ST
Rangolite (German)	96+ST
Rangolite (Czech.)	72.00
Rangolite (China)	65.00
Sodium sulphate (Fine)	3.75
Sodium sulphate (Coarse)	3.50
Sodium sulphide 50-52% (Flakes)	11.50+ST
Sodium sulphide 58-60% (Flakes) (TCL)	25.00
Sodium sulphide pure (Flakes)	12.25
Sodium nitrite (Resale) per 50 kg.	1,300.00
Sodium chlorite 80% (Spain)	100+ST
Soda Ash (Tata)	5.00
Soda Ash (Birla)	5.00
Soda Ash (Imp.)	5.00
Sodium bicarbonate	7.00
Sodium bisulphite	8.00
Sodium silicate	5.50
Sodium acetate	8.00
Sodium alginate	450.00
Titanium Dioxide (Anatase)	65.00
Titanium Dioxide (Rutile – RCR_2)	95+ST
Tartaric acid	220.00
Trisodium phosphate	12.00
Thiourea	78.00
Urea (Tech.)	3.00
Vacuum salt	1.00
Zinc Dust	52.00
Zinc Oxide	58.00
Zinc chloride powder (Tech.)	20.50
Zinc sulphate	7.00

SOLVENTS	Per Kg.
Acetic Acid Glacial (Resale)	16.50
Acetic Anhydride (Resale)	37.00
Acetone (Resale)	25.00
Adipic Acid	90.00
Aceto Acetanilide	72.00
Aniline Oil (HOC)	50.00
Benzoate Plasticiser	62.00
Butyl Acrylate	85.00
Butyl stearate	38.00
Butanol	34.00
Benzyl Alcohol	60.00
Benzyl Chloride	34.00
Benzo trichloride	16.00
Benzoyl chloride	22.00
Bromine Liquid	68.00
Chloroform	30.00
Carbon Tetrachloride	20.00
Cellosolve	65.00
Cyclohexanone	64.00
Cyclohexanol	58+ST
Diacetone (Resale)	26.75
Diethyl Oxalate	34.00
Diethyl glycol (DEG) (Resale)	38.00
Dioctyl Phthalate	60.00
Diallyl Phthalate	44.00
Dimethyl Phthalate	48.00
Dioctyl Adipate	58.00
Dibutyl Adipate	42.00
Dipentene	15.00
Dimethylamine 40%	30.00
Dimethylamine 50%	35.00
Ethyl Acetate	22.50
Ethyl Acrylate	70.00
Ethylene Dichloride	18.00
Ethylene Glycol	38.00
Formic Acid (Imp.)	24.00
Formaldehyde (Resale)	7.25
Glycerine (CP)	48.00
Glycerine (IW)	55.00
Hydrogen Peroxide 50% (Resale)	34.00
Isopropyl Alcohol	38.00
Isobutyl Alcohol (Resale)	35.00
Monoethanolamine (Resale)	105.00
Melamine	60.00
Methyl Ethyl Ketone	58.00
Methyl Isobutyl Ketone	42.00
Methyl Acrylate	72.00
Methylene Dichloride (Resale)	21.00

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Di Octyl Phthalate (D.O.P.)
Di Octyl Maleate (D.O.M.)
Di Butyl Phthalate (D.B.P.)
Di Octyl Adipate (D.O.A.)
Di Butyl Maleate (D.B.M.)
Butyl Stearate

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Hydroxylamine Sulphate
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Iso Propyl Alcohol
Lithium Hydroxide
Magnesium Oxide
Malonic Acid
Methyl Cellulose 4000
Methyl Cellosolve
Methyl Formate
Morpholine
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Para formaldehyde 84-85%
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Phone: 321020/335736/344937 Residence: 6124644/6122149

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Meta Cresol	45.00
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Nitric Acid (Conc.) (RCF)	2.50
Octanol	52.00
Ortho Cresol	30+ST
Phenol (Resale)	46.00
Propylene Glycol	52.00
Polyethylene Glycol (No.200)	75.00
Polyethylene Glycol (No.400)	75.00
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Polyethylene Glycol (No.4000)	95.00
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Styrene Monomer	50.00
Sorbitol	14.00
Sulphuric Acid	2.80
Trichloroethylene	26.00
Triethanolamine (Resale)	95.00
Turpentine Oil (Germany)	8.00
Turkey Red Oil (50%)	20.00
Vinyl Acetate Monomer	55.00

SOLVENTS	Per Litre
Benzene	14.50
N-Heptane	10.50
N-Hexane	11.00
Methanol	9.25
Solvent Naphtha Heavy	10.50
Solvent Naphtha Light	8.50
Toluene	16.00
Xylene	31.00

DYES INTERMEDIATES (PRICES ARE WITHOUT TAX AND EXCISE)

Alphanaphthylamine	55.00
Alpha Naphthol (Imp.)	160.00
Aceto Acetic Ester (Methyl)	85.00
Ammonium Molybdate	225.00
Anthraquinone	155.00
Anthranilic Acid	100.00
2-Amino 4-Nitrophenol	140.00
Blue B. Base (Local)	315.00
Beta Naphthol (Atul)	60.00
Benzidine Dihydrochloride (BDH)	82.00
Bromamine Acid	510.00
BON Acid (Incl. of excise)	150.00
Chicago Acid (Atul)	340.00
Coach Acid	58.00
C. Acid (Imp.)	195.00
Cyanuric Chloride	166.00
2,4- DNCB	32.00
Dihydrothio PTOS (Imp.)	1,600.00
Dimethyl Aniline	65.00
Diethyl Aniline	125.00
Diamino stilbene disulphonic acid	165.00
3,3-DCB (Imp.)	215.00
Gamma Acid (Atul)	195.00
H. Acid (Atul)	123.00
G. Salt	60.00
J. Acid	375.00
J. Acid Urea	450.00
K. Acid	110.00
MPDS (German)	190.00
MNA	135.00
Meta Ureido Aniline	175.00
MPD (Local)	190.00
MPD (Japan)	185.00
Naphthenic Acid	46.00
N-Methyl J. Acid	510.00
N-Methyl Aniline	135.00
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Para Anisidine (PA local)	145.00
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Para Cresidine (Imp.)	325.00
Para Amino Azo Benzene (India)	135.00
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Para Amino Acetanilide	195.00
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Sodium Naphthionate	62.00
5-Sulpho-Anthranilic Acid	100.00
Sulphanilic Acid	33.00
Sulpho Tobias Acid	185.00
Trichloro Benzene (TCB)	28.00
Tobias Acid (Imp.)	135.00
Metanilic Acid	42.00
MTD (German)	130.00

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- N T A
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Telex : 021-7917 SBIL IN
Madras : Phone : 582046
Telex : 041-7527 SBIL IN

Bangalore : Phones: 570746-570760
Telex : 0845-8275 SBIL IN
Hyderabad : Phones : 73737-831049
Poona : Phone: 50797

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Bombay 400 034.
Telex No.: 011-71682-CHEM IN

Phones: 4938395
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Contact Manufacturers:

DADIA CHEMICAL INDUSTRIES

346, Samuel Street, Vadgadi, Bombay 400 003.
Tel.: 348745/323718 * Res.: 5134435/5121418

Bombay Drugs Market

(Prices as on November 14, 1990)

Product	Rs./kg.	Product	Rs./kg.	Product	Rs./kg.
Acriflavine DPC	850.00	Disodium Hydrogen Citrate	43.00	Niacin	220.00
Aluminium Hydroxide IP	45.00	Ephedrine HCL	1850.00	Niacinamide	250.00
Ampicillin Trihydrate	1800.00	Erythromycin Estolate	2350.00	Nifedipine	1100.00
Aminophylline	350.00	Erythromycin Stearate	2100.00	Nitrofurazole	280.00
Albendazole	2100.00	Ethambutol IP	875.00	Oxyphenbutazone	775.00
Analgin	280.00	Ethophylline	650.00	Papaverine HCl	2000.00
Aspirin IP	90.00	Ferrous Fumarate	41.00	Paracetamol	200.00
Atenolol	2900.00	Folic Acid IP	3200.00	Pectin IP	425.00
Benzoic Acid IP.	34.00	Furosemide IP	2200.00	Pepsin 1:3000	375.00
Bromine	67.00	Furazolidone IP	385.00	Phenbarbitone	510.00
Bromhexine HCL	2300	Guanidine Nitrate	40.00	Pheniramine Maleate	1250.00
Butylated Hydroxy Toluene	650.00	Gallic Acid	320.00	Phenyl Butazone USP	550.00
Caffeine Citrate IP	390.00	Haloperidone	19,000.00	Piperazine Citrate	95.00
Caffeine IP	400.00	Hematropine Methyl Bromide	12.00	Piperazine Hexahydrate	85.00
Calcium Gluconate IP	45.00	Hydrazine Hydrate	100.00	Potato Starch	65.00
Calcium Glycerophosphate	160.00	Ibuprofen IP	365.00	Propanolol HCL	1100.00
Calcium Lactate	40.00	Indomethazine	860.00	Pseudoephedrine HCL	2200.00
Calcium Phenthonate	670.00	I.N.H.	270.00	Pyrazinamide	1225.00
Cetrimide IP	210.00	Inosite IP	900.00	Ranitidine	2800.00
Chlorbutol	95.00	Iodochloro Hydroxyquinoline	500.00	Rifampicin IP	3900.00
Chlorhexidine Gluconate 20% BP	225.00	Lactose IP	40.00	Saccharine Sodium	215.00
Chloroquin Phosphate	850.00	Lactic Acid	90.00	Salbutamol Sulphate	7300.00
Chlorpromazine HCL	1500.00	Levamisole	1500.00	Sodium Iodide	425.00
Choline Chloride FG	35.00	Lignocaine HCl	350.00	Sodium Methoxide	105.00
Choline Chloride IP	58.00	Lignocaine Base	350.00	Sorbitol Powder	115.00
Cloxacillin Sodium	2200.00	L. Lysine Feed	95.00	Sorbitol USP	13.00
Cimetidine	2100.00	L. Lysine Pharma	300.00	Sulphacetamide	300.00
Citric Acid IP	45.00	Magnesium Hydroxide	30.00	Sulphamethoxazole	345.00
C.P. Maleate	1050.00	Magnesium Trisilicate IP	12.00	Tinidazole	375.00
Cyproheptadine Tcl	9500.00	Mannitol USP	102.00	Theophylline Anhydrous	370.00
Diazepam	800.00	Mebendazole	625.00	Thiacetazone	260.00
Dicyclomine Hcl	1500.00	Mercurochrome NF	280.00	Tolbutamide	200.00
Diethyl Carbamazine Citrate	300.00	Methyl Chloroformate	85.00	Trimethoprim IP	1050.00
Di-iodohydroxyquinoline	525.00	Metochlopromide TCL	2200.00	Vitamin A Palmitate	2600.00
Diloxanide Fumarate IP	575.00	Metronidazole IP	450.00	Vitamin B6 Hydrochloride	1450.00
Diphenhydramine HCL	260.00	Morpholine	115.00	Vitamin B2 5-Phosphate	4100.00

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Tel.: 4375582/4371701

Bombay Dyes Market

(Prices as on November 14, 1990)

ACID COLOURS	Per Kg.
Acid Violet 4BS	*190.00
Acid Maroon V	110.00
Acid Orange II	112.55
Acid Orange IIY	93.85
Acid Red A	137.00
Acid Scarlet 3R	128.35
Acid Red 38N	*195.00
Acid Hed R2R	132.00
Acid Red RS	88.00
Acid Patent Blue AS	*280.00
Acid Green V	*375.00
Acid Coomasi Blue	200.00
Acid Yellow 5GN	65.00
Acid Red PG	85.00
Acid Red GRS	78.00
Acid Black 10 BX	157.15
Acid Black BX	126.95
Acid Black Wax	135.50
Crosein Scarlet MOO	200.30
Procinil Yellow GS (ICI, UK)	265.00
Procinil Red GS (ICI, UK)	530.00
Procinil Blue RS (ICI, UK)	315.00
Procinil Scarlet G (ICI, UK)	600.00
Procinil Orange G (ICI, UK)	250.00
Procinil Rubine (ICI, UK)	550.00

* To get resale price add 6% tax.

DIRECT COLOURS	Per Kg.
Yellow 3GX	114.00
Gun Yellow RCH	175.85
Fast Yellow GCH	171.50
Yellow CFG Hly. Conc.	721.00
Fast Yellow GS	126.96
Fast Yellow CHRS	116.85
Viscose Orange A	210.35
Fast Orange GR	171.50
Red	122.65
Dark Tan	98.15
Red IIR	98.15
Red 4B	217.55
Bordeaux BW	170.10
Fast Scarlet 4BS	223.50
Red 12B	220.45
Bordeaux Hly. Conc.	249.20
Cotton Red N	117.05
Brill. Fast Helio B	362.85
Brill. Fast Helio 2R	385.83
Brill. Fast Helio 2RS	177.30
Brill. Fast Helio BS	116.10
Brill. Violet Extra	181.45
Blue 2B	102.50
Blue G	220.45
Sky Blue FB	242.00
Copper Blue GR	190.25
Fast Greenish Blue GL	114.60
Developed Black BT	149.95
Blue NB-2B	348.45
Blue NB-2BG	214.70
Developed Black NB-GHB	214.70
Green B	142.75
Green NB-B	218.90
Green 2B-N	218.90
Brown MR	197.40
Brown CN	137.00
Golden Brown G	175.85
Catechin G	155.70
Omega Tan	161.45
Catechin GS	102.80
Black E Hly Conc.	180.15
Black E Extra Hly. Conc.	180.15
Black NB-ER Hly. Conc.	290.50

DISPERSOL COLOURS	Per Kg.
Red B 3B Conc.	611.50
Red B 2B Conc.	797.90
Red CB Powder	1048.25
Red D2B Powder	580.65
Violet C 4R	1202.70
Blue BG Powder	580.65
Blue BN Powder	128.25
Blue D 2R Powder	588.25
Navy BT Conc.	531.95
Blue B 2G Conc.	577.95
Blue BT Conc.	319.50
Blue BR	482.40
Yellow 7GL	813.20
Yellow 5RX	269.90
Yellow 3G	473.20
Yellow	140.00
Yellow AL	167.20
Yellow Brown REL	311.70
Yellow FFL	571.40
Gold Yellow GG	320.80
Pink REL	593.00
Red BEL	615.60
Red 2B	422.40
Red FB	425.80
Red Violet FBL	622.00
Orange 3R	254.20
Violet 3R	370.50
Violet RL	355.70
Violet 6R	638.20
Scarlet RR	283.50
Rubine 3B	289.10
Rubine CB	449.50
Blue GL	419.00
Blue BGF	805.80
Navy Blue RE	359.90
Brown 3REL	272.80
Black GEL	420.10
Dark Brown 3B	411.10

BASE COLOURS	Per Kg.
Fast Yellow GC	77.75
Fast Orange GC	128.40
Fast Scarlet R	198.05
Fast Scarlet RC	128.40
Fast Scarlet RCR	105.60
Fast Scarlet G	115.75
Fast Scarlet GN	92.95
Fast Scarlet GG	77.75
Fast Scarlet GGS	73.95
Fast Red B	233.50
Fast Red RC	115.75
Fast Red R Flakes	158.80
Fast Red TR	181.60
Fast Red TR Oil	223.35
Fast Red RL	251.20
Fast Red KB Oil	251.20
Fast Bordeaux GP	236.00
Fast Garnet GBC	103.05
Fast Violet B	548.80
Fast Blue BB	566.50

NAPHTHOL COLOURS	Per Kg.
ASG	301.85
AS	205.65
ASSW	379.10
ASBS	253.75
ASBO	266.40
ASD	209.45
ASCL	243.60

ASTR	369.00
ASPH	336.05
ASE	236.00
ASEL	249.95
ASLB	2,002.35
ASBT	2,459.45
ASWG	143.00
ASSG	538.65
ASSR	652.60

PROCION COLOURS	Per Kg.
Golden Yellow HR	207.95
Brill. Yellow H4G	145.65
Supra Yellow H-8GP	168.55
Brill. Yellow HE6G	214.75
Yellow G-E4R	276.05
Brill. Yellow H7G	332.30
Yellow M4R	275.45
Yellow M GR	387.65
Brill. Yellow M4G	201.15
Brill. Yellow M8G	366.10
Yellow M 3R	244.70
Brill. Orange H 2R	303.80
Brill. Red H 7B	157.95
Brill. Orange M 2R	313.15
Brill. Red H 8B	213.55
Brill. Scarlet H RN	245.05
Supra Red H-3BP	179.80
Brill. Red H-F3B	243.45
Brill. Magenta HB	182.00
Brill. Red M 5B	160.05
Brill. Red M 8B	218.35
Brill. Pink MB	137.10
Brill. Magenta MB	163.65
Brill. Purple H-3R	219.55
Brill. Purple H-7R	175.40
Navy Blue H 3R	333.75
Brill. Blue H-GR	406.40
Brill. Blue H 5G	207.95
Blue H 5RX	286.20
Brill. Blue H 7G	213.95
Brill. Blue H 7RX	358.15
Turquoise HA	265.05
Supra Blue H-3RP	595.30
Supra Turquoise H 2G P	181.50
Blue H-FRD	305.80
Navy Blue H ER	333.75
Blue H 5RX	286.20
Navy Blue M 3R	355.70
Brill. Blue MR	405.60
Brill. Blue M RX	214.20
Brill. Blue M-G	226.45
Blue M 4GD	369.40
Navy Blue M RP	341.85
Turquoise M-G	240.30
Brill. Blue M GX	516.25
Blue 3R Acra Powder	718.20
Dark Brown H 6R	248.45
Cobalt Oxide	285.00
Green H 4BD	287.00
Green H-E4BI	169.80
Red Brown H IF	143.25
Orange Brown H 28	209.05
Brown M GRN	188.80
Black H-N	314.20

SULPHUR COLOURS	Per Kg.
Navy Blue	210.35
Green G	194.55
Black Grains Extra	72.25
Black Grains OG	73.70
Black GXE Conc.	70.85
Black GXE	57.90
Black GXR	69.40
Black Grains 800	62.80
Black EXR Grains	73.70
Black EXR Grains 800	59.35

VAT COLOURS (ICI)	Per Kg.
Yellow 5G Supra Disperse	561.85
Yellow 5G Acra Con.	818.60
Gold Orange 3G Pdr. Fine	1158.45
Brill. Orange 6R Pdr. Fine	624.35
Gold Orange 3G Supra Disp.	693.85
Brill. Orange 6RX Powder	394.30
Brill. Red 3B Pdr. Fine	1214.15
Brill. Red 3B Supra Disp.	867.45
Brill. Purple 3R Acra Powder	827.05
Brill. Purple 2R Hly. Conc.	744.25
Brill. Purple 4R Supra Disp.	604.25
Brill. Purple 2R Acra Conc.	779.85
Blue 2R Pdr. Fine	675.30
Blue BC Acra Conc. Pdr. Fine	1013.15
Blue BC Conc. Pdr. Fine	713.65
Blue R Conc Pdr. Fine	719.70
Blue Conc. Powder	645.80
Brill. Blue 2R Hly. Conc.	378.55
Blue RR Supra Powder	629.35
Brill. Blue 2R Supra Disp.	115.65
Dark Blue 2R Powder Fine	512.65
Blue BC Supra Disp.	419.65
Jade Green XBN Powder Fine	555.80
Jade Green XBN Acra Conc. Pdr.	1026.05
Jade Green 2G Pdr. Fine	533.25
Jade Green 2G Ptg. Paste	125.40
Jade Green XBN Ptg. Paste	126.00
Jade Green 2G Supra Disp.	618.00
Olive D Pdr. Fine	563.90
Olive Green B Supra Disp.	421.70
Jade Green XBN Supra Disp. (N)	327.30
Olive OMW Pdr. Fine	698.55
Olive OMW Supra Disp.	538.05
Olive D Supra Disp.	361.70
Olive R Supra Disp.	470.25
Olive D Ptg. Paste	193.00
Olive Green B Ptg. Paste	199.10
Olive Green B Acra Conc.	741.10
Olive R Acra Conc.	779.85
Brown R Pdr. Fine	869.45
Dark Brown 3R Fine	826.25
Brown G Supra Disp.	582.05
Brown 2G Supra Disp.	716.10
Brown R Supra Disp.	547.35
Brown BR Powder	867.75
Dark Brown 3R Ptg. Paste	217.15
Dark Brown 3R Supra Disp.	529.60
Brown G Acra Conc.	967.95
Brown M. Powder Fine	768.80
Grey M. Supra Disp.	585.45
Blue BC Acra Conc. Pdr. Fine	762.70
Direct Black AC Supra Disp.	415.75
Direct Black AC Pdr. Fine	574.70
Direct Black CH Supra Disp.	490.45
Direct ACD Ptg. Paste	217.15

Delhi Market

DELHI: NOVEMBER 9: NNS Slack wax registered a marked rise of Rs. 400 at Rs. 11,900 per tonne in the Delhi chemicals market during last week, on account of spurt in demand from refined wax manufacturers induced by dwindling supply, reports NNS. Match and residue wax remained firm at their previous closing of Rs. 20,000 and Rs. 4,900 per tonne respectively. Hydrogen peroxide, however, ruled quiet at Rs. 34/35 per kg due to better supply of imported goods.

As a result of increased stocking monopoly, sodium hydrosulphite Damosha and Kalali jumped up by Rs. 2/3 at Rs. 48 and Rs. 50 per kg. Gulshan and hydro Tamil Nadu forged ahead by Rs. 2.50/3 at Rs. 45 and Rs. 46 per kg. Following dwindling supply from manufacturers, sufolite rose from Rs. 67 to 70 per kg. On account of poor supply from Bombay and rise in demand from consumers, chatkolite hardened further by Rs. 1.50 at Rs. 66. Demand was also reported to be good from gur and khandsari manufacturers. Caustic soda flakes looked up by Rs. 10 at Rs. 560 per 50 kg due to negligible supply from Modi and Gwalior Rayon. Camphor powder shot up by Rs. 10 at Rs. 110 and thal improved by Re. 1 at Rs. 110 in view of raise in its prices by the manufacturers. As a result of reduced supply from UP due to curfew in many areas, menthol flake advanced by Rs. 3 at Rs. 268 per kg. Menthol medium and bold also held steady at Rs. 285 and Rs. 295 per kg respectively.

Borax granular, crystal and citric acid (Chinese) slipped by Rs. 25 each at Rs. 1,000, Rs.1,000 and Rs. 2,200 per 50 kg respectively in the absence of demand from outstation consumers. Boric acid technical dropped by Rs. 100 at Rs. 2,500 thanks to increased profit taking selling by stockists. Sodium sulphate Gwalior Rayon, DCM (Black marka) tumbled down by Rs. 300 at Rs. 4,100 and Rs. 4,200 per tonne.

In the absence of buying interest, titanium dioxide TTP drifted lower by Re. 1 at Rs. 63 per kg. Ammonia bicarb quoted cheaper by Rs. 2 at Rs. 180 (per 25 kg) on withdrawal of demand from bakeries. No change was noticed in the prices of dyes and colours during the week.

(DELHI MARKET RATES AS ON NOVEMBER 9, 1990)

Ammonia Bicarb (Per 25 Kg.)	180.00
Mercury (Per flask)	10,700.00
Soda ash (Per bag)	365/375.00
Ammonium Chloride (50 Kg.)	140/180.00
Caustic soda flakes (50 Kg.)	560.00
Citric acid (Per 50 Kg.)	2,200/2,450.00
Stable Bleaching Powder Shriram (Per 25 Kg.)	101.00
Stable Bleaching Powder KCI (Per 25 Kg.)	90.00
Stable Bleaching Powder Maruti (Per 25 Kg.)	91.00
Stable Bleaching Powder Modi (Per 25 Kg.)	92.00
Sodium Bicarbonate (50 Kg.)	325/350.00
Sodium Hydrosulphite (Per Kg.)	45/50.00
Rangolite (Per Kg.)	100.00
Tartaric acid France (Per Kg.)	314.00
Sufolite (Per Kg.)	70.00
Chatkolite (Per Kg.)	66.00
DMO (per Kg.)	75.00
Boric acid Technical (Per 50 Kg.)	2,500.00
Paraffin Wax (Per 50 Kg.)	1,200.00
Slack wax (Per metric tonne)	11,900.00
Tartaric Acid (France Per Kg.)	314.00
Tartaric Acid (Swastik Per Kg.	210.00
Borax Granular (Per 50 Kg.)	1,000.00
Borax Crystal (Per 50 Kg.)	1,000.00
Sodium Nitrite (Per 50 Kg.)	1,050/1,200.00
Sodium Nitrate (Per 50 Kg.)	520.00
Camphor Thal (Per Kg.)	115.00
Camphor Powder (Per Kg.)	110.00
Menthol Bold (Per Kg.)	295.00
Menthol Medium (Per Kg.)	285.00
Menthol Flake (Per Kg.)	268.00
Mentha Oil (Per Kg.)	180.00
Glycerine (Per Kg.)	53/56.00
Sodium Silicate (Per quintal)	300/400.00
Hexamine (Per Kg.)	34.00
Acetic Acid Glacial (Per Kg.)	16.50
Copper Sulphate (Per quintal)	2,400/2,600
Formic Acid (Per Kg.)	25.00
Formaldehyde (Per Kg.)	8.50
Hydrogen Peroxide (Per Kg.)	34/35.00
Calcium Carbonate (Per Tonne)	2,800/5,800
Acid Slurry Soft (Per Kg.)	42.00
Acid Slurry Hard (Per Kg.)	35.00
Phosphoric Acid (Per 50 Kg.)	1,230.00
Potassium Nitrate (Per quintal)	1,000/1,250.00
Potassium Permanganate (Per 50 Kg.)	2,600/3,000.00
Sodium Bichromate (Per 50 Kg.)	1,575/1,600.00
Trisodium Phosphate (50 Kg.)	710.00
Titanium Dioxide Anatase T.T.P. (Per Kg.)	63.00
Titanium Dioxide RC-822 (Per Kg.)	85.00
Titanium Dioxide Anatase K-Brand (Per Kg.)	59.00
Titanium Dioxide RCR-2 (Per Kg.)	90.00
Zinc Oxide (Per Kg.)	46.00/50.00
Phenol Carbolic Acid (Per Kg.)	48.00
Carbon Tetrachloride (Per Kg.)	24.75
Chloroform (Per Kg.)	28.00
Sodium Sulphate (Per metric tonne)	4,300/4,600.00
Naphthalene Balls (Per 50 Kg.)	1,500.00
Match Wax	20,000.00
Residue Wax	4,900.00

DYES & COLOURS	**(Per Kg.)**
Naphthol AS	175/211.50
Naphthol ASG	180/249.70
Naphthol ASBS	210/260.75
Naphthol ASTR	300/378.92
Naphthol ASOL	210/250.90
Naphthol ASBO	195/274.30

DIRECT DYES	**(Per Kg.)**
Black E. Conc.	120/185.30
Diazo Black B.T.	105/154.50
Green B	90/147.55
Blue 2-B	60/107.00
Blue 2-B 225% (JNR)	125.00
Sky Blue FB	160/248.20
Basic Auramine	55/110.00
Basic Rhodamine	315/425.00
Basic Methylene Blue	100/180.00
Basic Violet	165/210.00
Basic Malachite Green	185.00
Acid Orange	75/111.20
Congo Red H/C	85/120.95

Madras Market

Prices are firming up. There has been a slight increase in the prices of caustic soda flakes. Hydrogen peroxide prices had gone up to Rs. 38 mainly on account of increase in price by manufacturers. Prices of dyes intermediates have reacted sharply on account of increase in prices of petrochemical solvents. Methyl ethyl ketone prices shot up due to non-availability. The spurt in the prices has created a temporary lull in the market activity.

(MADRAS MARKET RATES AS ON NOVEMBER 10, 1990)

Acetic Acid Glacial (per kg)	16.00
Aluminium Sulphate Iron free (per MT)	4,500.00
Ammonium Bicarbonate (per 25 kgs)	165.00
Ammonium Chloride (per MT)	3,000.00
Acid Slurry (per kg)	33.00
Barium Carbonate (per kg)	11.00
Barium Chloride (per kg)	10.00
Boric Acid Technical (per kg)	28.00
Bleaching Powder (per 50 kgs)	220.00
Borax (per 50 kgs)	825.00
Caustic Soda Flakes -- Mettur Chemicals (per MT)	11,500.00
Caustic Soda Flakes -- Andhra Sugars (per MT)	11,500.00
Calcium Chloride 70% Solid (per MT)	3,800.00
Calcium Chloride Anhydrous (per MT)	6,500.00
Calcium Carbonate (Activated) (per MT)	6,750.00
Calcium Carbonate (Precipitated) (per MT)	5,600.00
Citric Acid (per kg)	48.00
Copper Sulphate (per kg)	24.00
Cresylic Acid 98-99% (per kg)	138.00
Pure Para Cresol 96% (per kg)	102.00
Meta Para Cresol 42% (per kg)	53.00
Formic Acid (per kg)	27.00
Formaldehyde (per kg)	9.00
Glue Flakes (per kg)	15.00
Glycerine I.W. (per kg)	48.00
Hydrosulphite of Soda (TCPL) (per kg)	42.00
Hydrosulphite of Soda (IDI) (per kg)	45.00
Hydrosulphite of Soda (BASF) (per kg)	48.00
Hexamine (per kg)	35.00
Hyflosupercell (per kg)	30.00
Hydrogen Peroxide (per kg)	38.00
Litharge (per kg)	40.00
Lead Acetate (per kg)	40.00
Magnesium Carbonate (per kg)	17.00
Magnesium Chloride (per kg)	4.00
Maleic Anhydride (per kg)	48.00
Menthol Crystals (per kg)	325.00
Oxalic Acid (per kg)	17.00
Paraffin Wax (per kg)	25.00
Potassium Bichromate (per kg)	40.00
Phosphoric Acid (per kg)	32.00
Polyvinyl Alcohol Powder (per kg)	160.00
Pentaerythritol (per kg)	55.00
Phthalic Anhydride (per kg)	55.00
Soda Ash (TAC) (per 75 kgs)	425.00
Soda Ash (TATA) (per 75 kgs)	425.00
Sodium Bicarbonate (TATA) (per 50 kgs)	385.00
Sodium Silicate (per MT)	4,000.00
Sodium Bichromate (per kg)	33.00
Sodium Nitrate (per kg)	9.00
Sodium Nitrite (per kg)	22.00
Sodium Sulphide Flakes (per kg)	20.00
Sodium Bisulphite (per kg)	8.00
Sodium Alginate (per kg)	350.00
Sodium Acetate (per kg)	8.00
Sodium Sulphate (Anhydrous) (per kg)	4.25
Titanium Dioxide (Anatase) (per kg)	65.00
Titanium Dioxide (Rutile) (per kg)	85.00
Trisodium Phosphate (per kg)	10.00
Urea (Technical) (per kg)	3.00
Zinc Oxide (per kg)	54.00
Zinc Chloride Powder (per kg)	14.00
Zinc Sulphate (per kg)	10.00

SOLVENTS

Acetone -- HOCL (per kg)	25.00
Butanol (per kg)	39.00
Butyl Acetate (per kg)	38.00
Benzene (per lit)	17.00
Cellosolve (per kg)	70.00
Carbon Tetra Chloride (per kg)	23.00
Chloroform (per kg)	28.00
Diacetone Alcohol (per kg)	34.00
Diethylene Glycol (per kg)	40.00
Dichloroethane (per kg)	20.00
Di-octyl Phthalate (per kg)	65.00
Di-N-butyl Phthalate (per kg)	65.00
Ethyl Acetate (per kg)	25.00
Isopropyl Alcohol (per kg)	33.00
Methanol (per kg)	14.00
Methylene Chloride (per kg)	23.00
Methyl Ethyl Ketone (per kg)	45.00
Methyl Isobutyl Ketone (per kg)	46.00
Phenol (per kg)	48.00
Sorbitol (per kg)	16.00
Triethanolamine (per kg)	100.00
Trichloroethylene (per kg)	26.50
1-1-1 Trichloroethane (per kg)	29.00
Turpentine (per lit)	18.00
Toluene (per lit)	18.00
Xylene (per lit)	30.00

CALCUTTA MARKET (Prices as on Nov. 11, 1990)

Acetic acid (per 50 kg)	750.00
Basic chrome sulphate (per 50 kg)	810.00
Benzene (litre)	11.50
Bleaching powder (bag)	240.00
Borax granular (per 50 kg)	810.00
Boric acid (per 50 kg)	1,625.00
Camphor (per kg)	102.00
Caustic soda lye (per ton)	NA
Caustic soda flakes (per 50 kg)	555.00
Glycerine (per kg)	53.50
Menthol bold (per kg)	570.00
Menthol medium (per kg)	380.00
Menthol small (per kg)	300.00
Phosphoric acid (per 50 kg)	850.00
Phenol (per 50 kg)	1,550.00
Soda ash (75 kg)	295.00
Sodium bichromate (per 50 kg)	1,150.00
Sodium bicarbonate (per 50 kg)	285.00
Sodium nitrate (per 50 kg)	380.00
Sodium sulphate anhydrous (per 50 kg)	NA
Sulphuric acid (per ton)	1,600.00
Trisodium phosphate (per 50 kg)	390.00
Toluene (litre)	12.50

Shipping News

VESSELS DUE IN BOMBAY FOR EXPORT LOADING

Due Date (1)	Steamer's Name & Flag (2)	Agents (3)	Will load for (4)	Approx. sailing dt. (5)
20/11	Ocean Strength (V-28A/B)	O.S.A.	New York, Baltimore; Philadelphia; Houston; Boston; Chicago; Dallas; Atlanta; Savannah; Norfolk; Charleston; Los Angeles; San Francisco; Oakland; Seattle; Vancouver; Toronto; Montreal; Portland; Tacoma & S. American & West Indies Ports. (Carting at B. Pier Extn.)	30/11
20/11	Ever Bridge (V-042)	Greenways	New York; Newark; Baltimore; Charleston; New Orleans; Houston; Boston; Providence (RI); Philadelphia; Norfolk; Savannah; Jacksonville; Wilmington; Miami; Montreal; Toronto; Bermuda; Los Angeles; Longbeach; San Francisco; Oakland; San Diego; Stockton; Richmond; Almeida; Redwood City; Sacramento; Seattle; Portland; Vancouver (B.C.); Tacoma; Longview; Chicago; Dallas; Various inland destinations & Caribbean Ports. (Carting at G/H Cotton Depot).	27/11
4/12	Rhine Forest (V-118)	M.S.P.L.	Philadelphia; Baltimore; Norfolk; New Orleans; Houston; Savannah; New York. (Carting at P/Q-PD).	5/12
26/11	Anika Oltmann	Samrat/ Hindustan/ L. Triest	Boston; New York; Baltimore; Norfolk; Charleston; P. Mouth; P. Lauderdale; Miami; New Orleans; Savannah; Jacksonville; P. Everglades; Philadelphia; Halifax; Montreal; Toronto; & S. American Ports. (Carting at M.O.D. No. 1 for Samrat & Hindustan) (Carting at M-171/173 C.D. for L. Triest).	1/12
19/11	Leninskiy Pioner	Marathon	Boston; New York; Baltimore; Norfolk. (Carting at T.P. No. 3).	22/11
3/12	Hoegh Dene	Patvolk	Montreal & Toronto Via Halifax; New York; Boston; Norfolk; Charleston; Houston; Savannah; Wilmington; Philadelphia; Baltimore; New Orleans & FCL Chicago; Milwaukee; Atlanta; Dallas. (Carting at H.B. No. 5).	8/12
26/11	Anika Oltmann	L. Triest	With T.P. Lagos/Apapa; Abidjan; Dakar; Douala; Cotonou; Noucakchott; Libreville; Matadi; Conakry; Freetown. (Carting at M-171/173 C.D.).	1/12
20/11	Ever Bridge (V-042) (Pan)	Greenways	Hamburg; Felixstowe; Rotterdam; Atnwerp; Le Havre; London; Liverpool; Leixoes; Lisbon; Manchester; Avonmouth; Wembly; Birmingham; Leeds; Leicester; Amsterdam; Bremen; Copenhagen; Aarhus; Gothenburg; Oslo; Stockholm; Helsinki; Belfast & All Destinations in U.K.; Germany; Switzerland & Austria. (Carting at G/H Cotton Depot).	27/11
19/11	Leninskiy Pioner (Rus)	Transocean/	Tilbury; Avonmouth; Liverpool; Manchester; London; Felixstowe; Birmingham; Antwerp; (Rotterdam); Hamburg; Bremen; Copenhagen; Gothenburg; Oslo; Stockholm; Malmao; Leeds. (Crtg. at T.P. No. 3).	22/11
		I.S.S. Co.	Felixstowe; Tilbury; Antwerp; Rotterdam; Hamburg; Bremerhaven & Scandinavian Ports via Hamburg. (Carting at E-Grain Depot).	
26/11	Anika Oltmann	Samrat/ Hindustan/	Felixstowe; Hamburg; Rotterdam; Also London; Liverpool; Leixoes; Lisbon; Manchester; Avonmouth; Wembly; Birmingham; Leicester; Le Havre; Bremen; Amsterdam; Antwerp; Copenhagen; Leeds; Aarhus; Gothenburg; Oslo; Helsinki; Stockholm; Belfast & All destinations in U.K.; Benelux; Germany; France; Switzerland & Austria; Barcelona; Marseilles; La Spezia; Livorno; (Leghorn); Genoa; and other Italian Ports and FCL only Beirut; Alexandria; Valletta; Limmassol; Larnaca; Lattakia; Mersin; Izmir. (Carting at M.O.D. No. 1 for Samrat and Hindustan).	1/12
		Killick/	Felixstowe; Rotterdam; Hamburg; Antwerp; Le Havre; Lisbon; Leixoes; London; Liverpool; Manchester; Bristol; Avonmouth; Leeds; Glasgow; Tilbury; Birmingham; Dublin; Belfast; Bremen; Bremerhaven; Aarhus; Gopenhagen; Gothenburg; Helsinborg; Oslo; Helsinki; Alexandria; Lattakia; Mersin; Malta; Limmassol; Piraeus. (Carting at E-Shed Grain Depot).	
		L. Triest	Felixstowe & U.K. Inland Destinations; Hamburg; Rotterdam & Inland destinations in Cont.; Genoa; Leghorn; La Spezia; Naples; with TP Las Palmas; Stancruz de Teneriffe; Malta; Limmassol; Alexandria; Tunis; Benghazi. (Carting at M-171/173 Cotton Depot).	

(1)	(2)	(3)	(4)	(5)
12/11	S/o. Gujarat (Ind)	S.C.I.	Malta; Antwerp; Rotterdam; Hamburg; Bremen. (Breakbulk only).	25/11
4/12	Rhine Forest	M.S.P.L.	Assab; P. Suez; Alexandria. (Carting at P/Q-PD).	5/12
16/11	Topusko (Yug)	Oceanic	Hodeidah; Jeddah; P. Said; Rijeka.	26/11
3/12	Tibor Szamuely (Rus) (V-113 W/B)	Transocean	Odessa; Izmail; Reni (USSR); Russe; Bulgaria; Budapest (Hungary); Linz; Vienna (Austria); Bratislava (Czechoslovakia); Deggendorff; Regensborg (West Germany). (All ports on River Danube). (Carting at N/O-PD & G-PD).	4/12
29/11	S/o. Nagaland	S.C.I.	Main Japan Ports; Busan; (Taiwan).	10/12
28/11	Fatima	SDS Corpn.	Singapore; Bangkok; Penang; P. Kelang; Malaysia.	5/12
20/11	Ocean Strength V-28A/B) (Lib)	O.S.A./	P. Kelang; Singapore; Kaohsiung; Hongkong; Bangkok; Kobe; Yokohama; Nagoya; Moji; Osaka; Busan; Tokyo; Shimizu; Keelung; Tsingtao; Quindao; Xiangang; Shanghai. (Carting at B. Pier Extn.).	30/11
20/11	Ever Bridge (V-042) (Pan)	Greenways	Singapore; Penang; Port Kelang; Bangkok; Djakarta; Surabaya; Manila; Cebu; Kaohsiung; Keelung; Osaka; Yokohama; Kobe; Shimizu; Moji; Nagoya; Busan; Hongkong. (Carting at G/H Cotton Depot).	27/11
Stream	Privolyev (Rus)	Transocean	Main Japan Ports; Vladivostok.	24/11
20/11	Ocean Strength	O.S.A.	Sydney; Melbourne; Adelaide; Brisbane; Fremantle; Auckland; Wellington; Lyttelton; P. Chalmers. (Carting at B. Pier Extn.)	30/11
19/11	Banglar Moni	Sai Ship	Mombasa; Dar Es Salaam. (Carting at E-Shed Grain Depot).	24/11
12/11	S/o. Gujarat (Ind)	S.C.I.	Seychelles; P. Louis (Direct); Tamatave. (Carting B. Pier Extn.)	25/11

VESSELS DUE FOR IMPORT DISCHARGE

Due Date	Steamer's Name	Agents	From
26/11	Anika Oltmann	Samrat/Hindustan/L. Triest	U.K. Cont. & Med.
22/11	Emerald Highway	K. Steamship	Japan
23/11	Harmony Stove	Prudential	Cont.
28/11	Lapis	J.M. Baxi	Cont.
24/11	Mizoram	S.C.I.	U.S., Canada
20/11	Ocean Strength (V-28)	O.S.A./ M.S.P.L.	Far East/U.S. Far East
23/11	Sapanca	Damani	Brazil
20/11	Star Ranger	S.W. & Co.	U.S./Canada

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Materials Imported/Exported

MATERIALS IMPORTED
MADRAS
(From 8.6.90 to 15.6.90)
(Prices quoted are c.i.f. values)
(Continued from previous issue)

5-DINITRO-2-FURFURALDEHYDE: From Netherlands: Eskayef Ltd., 10.23 Kgs., Rs. 11,11,150.

DYES: From China: Khaleel-ur Rahman & Co., 1,500 Kgs., Rs. 78,532; From France: Shripet Industries, 50 Kgs., Rs. 309.

EPOXY RESIN: From USA: BPL Systems & Projects Ltd., 2,617.54 Kgs., Rs. 1,25,715.

ETHYL CAPRYLATE: From FRG: Bush Boake Allen (I) Ltd., 255 Kgs., Rs. 46,922.

ETHYL CYANOACRYLATE: Darien Electric, 52.75 Kgs., Rs. 46,108.

ETHYLENE GLYCOL: From FRG: Elcot New Era Tech. Ltd., 1,320 Kgs., Rs. 42,698; Keltron Component, 5,500 Kgs., Rs. 1,53,762.

ETHYLENE GLYCOL MONOBUTYL ETHER: From USA: Quinn India Ltd., 13,536 Kgs., Rs. 2,95,270.

GUAIACOL: From Japan: Synthokem, 10,000 Kgs., Rs. 10,03,440.

GUM BENZOIN: From China: Union Trading Co., 1,372 Kgs., Rs. 20,386; From Indonesia: Bharat Indl. Corpn., 295 Kgs., Rs. 25,740; From Singapore: SPK Muniswaran, 1,797 Kgs., Rs. 25,410.

GUM ROSIN: From Indonesia: Ballarpur Inds., 54 Mts., Rs. 4,66,476; Bhadrachalam Paper Boards, 200 Mts., Rs. 18,50,402; Danalakshmi Paper Mills Ltd., 9,120 Kgs., Rs. 85,011; Servalakshmi Paper Boards, 8.88 Mts., Rs. 82,901.

GUM ROSIN WW: From Indonesia: Tamil Nadu Newsprint & Paper, 36 Mts., Rs. 3,17,605.

HEXAMETHYLENE DIAMINE Mts., Rs. 25,90,690.

HEXAMETHYLENE TETRAMINE: From FRG: Samson Rubber Inds., 450 gms., Rs. 49.

BETA HYDROXY ETHYL HYDRAZINE: From Netherlands: Eskayef Ltd., 15.205 Mts., Rs. 24,08,012.

HYDROXYLAMINE SULPHATE: From Japan: Bell Remedies, 17.5 Mts., Rs. 5,51,272; Siris Ltd., 35 Mts., Rs. 8,02,247; Standard Organics, 40 Mts., Rs. 7,52,470.

ISO BORNEOL POWDER: From China: Arun Enterprises, 12.5 Mts., Rs. 3,28,220; Esjaypee Impex P. Ltd., 12,500 Kgs., Rs. 3,28,254.

ISO BUTYL BENZENE: From USA: Buichem Inds., 27 Mts., Rs. 15,73,003; Shasun Drugs, 13,657 Kgs., Rs. 7,86,502.

LACTOSE WHITE 200: From Canada: Chordia Bros., 36 Mts., Rs. 4,39,776.

LINALOOL: From USA: Ambica Chemical Products, 907 Kgs., Rs. 1,17,131.

MANGANESE DI OXIDE: From Singapore: Indo National Ltd., 150 Mts., Rs. 10,76,751.

METHYL ACETO ACETATE: From USA: Siris Ltd., 92.016 Mts., Rs. 21,76,228.

METHYL CHLOROFORMATE: From Hungary: N. Arvind & Co., 4 Mts., Rs. 92,143.

METHYL ETHYL KETONE: From Singapore: Solchem, 12.74 Kgs., Rs. 1,13,659.

PARA NITRO PHENOL: From Japan: Keltron Component Complex, 235 Kgs., Rs. 30,473.

NOVALDIAMINE: From FRG: Thomson Drugs & Chem, 990 Kgs., Rs. 4,07,609.

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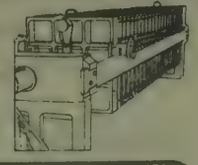

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OXAZEPIN: From USA: Veer Chemie & Aromatics, 150 Kgs., Rs. 3,32,799.

PARA OCTYL PHENOL: From FRG: Prakash Shipping Agencies, 6,000 Kgs., Rs. 1,73,840.

PARAFFIN WAX: From Singapore: IOC Ltd., 324 Mts., Rs. 43,35,554.

ALPHA PHENYL GLYCINE CHLORIDE: From Italy: Reddy's Labs. Ltd., 1,000 Kgs., Rs. 4,79,012.

PHOSPHINE: From UK: Bharat Electronics Ltd., 15 Nos., Rs. 80,507.

BETA PICOLINE: From USA: Vennan Chemicals P. Ltd., 5,211 Kgs., Rs. 2,93,734.

POLYVINYL ALCOHOL: From Singapore: Toplon I. Synthetics P. Ltd., 6 Mts., Rs. 1,98,946.

PROPYLENE GLYCOL ALGINATE: From Japan: Biocon India Ltd., 600 Kgs., Rs. 1,08,382.

PROPYLENE GLYCOL USP: From Singapore: Bush Boake Allen (I) Ltd., 51,600 Kgs., Rs. 8,55,468.

PYRIDINE: From Belgium: ICI India Ltd., 15,200 Kgs., Rs. 9,70,057.

AZO RIBITYLAMINE: From FRG: Babros Chemicals P. Ltd., 1,600 Kgs., Rs. 6,21,270.

SODIUM FORMATE: From Japan: Vikas Udyog, 20,000 Kgs., Rs. 53,805.

SILICA GEL: From FRG: Neyveli Lignite Corpn., 9.25 Mts., Rs. 5,74,716.

STANNOUS OCTOATE: From Switzerland: Flexible Foams Ltd., 50 Kgs., Rs. 13,089.

SULPHUR: From UK: Brakes India Ltd., 447 Kgs., Rs. 16,595.

SULPHUR HEXAFLUORIDE GAS: From Japan: N.G.E.F. Ltd., 1,170 Kgs., Rs. 1,16,974.

TITANIUM TETRACHLORIDE: From Japan: Widia (I) Ltd., 1,000 Kgs., Rs. 73,486.

TRIMETHOXY BENZALDEHYDE: From Netherlands: Standard Organics Limited, 6,090 Kgs., Rs. 24,81,616.

VANILLIN: From Switzerland: Sivashakti Perfumery Works, 400 Kgs., Rs. 57,010; From USA: Bush Boake Allen India Ltd., 3,000 Kgs., Rs. 7,85,314; The Mysore State Agarbatti Manuf., 1,000 Kgs., Rs. 2,40,603.

VANILLIN TECH.: From Norway: Dr. Reddy's Labs., 20 Mts., Rs. 41,88,338.

TETRA HYDROFURAN: From Japan: Nova Magnetics Ltd., 4,442 Kgs., Rs. 2,00,511.

PLASTIC MATERIALS IMPORTED MADRAS (From 8.6.90 to 15.6.90)

EPOXY RESIN: From China: Shree Tronics Enterprises, 300 Kgs., Rs. 30,742.

HDPE: From Japan: Asian Bags P. Ltd., 20,000 Kgs., Rs. 3,39,283; Sumitra Plastics, 70,000 Kgs., Rs. 11,65,406; 70,000 Kgs., Rs. 11,65,406; From Korea: Cochin Polypack P. Ltd., 16 Mts., Rs. 2,56,951; Gurukar Plastics Ltd., 32 Mts., Rs. 5,13,002; Safeback Polymers Ltd., 96 Mts., Rs. 15,27,776; Safeguard Pkg. Systems, 32 Mts., Rs. 5,11,574; Takas Poly Pack P. Ltd., 16,121 Kgs., Rs. 2,85,772; From Singapore: R.N. Polysacks P. Ltd., 15,625 Kgs., Rs. 2,13,656; Shiner Sacks P. Ltd., 15.625 Mts., Rs. 2,13,707; Shivashakti Polymers, 16,000 Kgs., Rs. 2,55,031; 15,500 Kgs., Rs. 2,11,761; 15.5 Mts., Rs. 2,11,652; 7.75 Mts., Rs. 1,05,026; S.R.S. Polysacks Ltd., 15.625 Mts., Rs. 2,15,050; 15.625 Mts., Rs. 2,15,050; Sun Polysacks, 15.5 Mts., Rs. 2,05,826; 15.625 Mts., Rs. 2,15,058; From UAE: Prakash Plastic Works, 17.15 Mts., Rs. 2,60,384.

POLYPROPYLENE: From Argentina: The National Small Inds. Corpn., 15 Mts., Rs. 2,38,539; From France: M.M. Rubber Co., 16,250 Kgs., Rs.

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2,50,992; From Japan: Electronic Res. Ltd., 6,000 Kgs., Rs. 5,23,542; From USA: Building Fibres P. Ltd., 33 Mts., Rs. 4,03,935; Sheba Polysacks P. Ltd., 66 Mts., Rs. 9,70,614.

POLYSTYRENE RESIN: From Hungary: Beardsell Ltd., 34 Mts., Rs. 8,34,628.

DRUG MATERIALS IMPORTED MADRAS (From 8.6.90 to 15.6.90)

CEPHALOSPORIN: From FRG: Eskayef Ltd., 5 Kgs., Rs. 1,726.

CHLORMEZANONE IP: From China: Chemech Labs Ltd., 20 Kgs., Rs. 14,020.

GENTAMYCIN SULPHATE BP: From Hong Kong: DWD Pharmaceuticals, 100 BTL., Rs. 3,11,065.

PLASTIC MATERIALS IMPORTED MADRAS (From 16.6.90 to 30.6.90)

HDPE: From Japan: Sumitra Plastics Ltd., 20,000 Kgs., Rs. 3,32,998; SPIC, 146.6 Mts., Rs. 23,58,448; Vimal Filaments Co., 20 Mts., Rs. 3,28,369; Jass Inds., 10 Mts., Rs. 1,49,708; From Korea: Lucky Gold Star Pack P. Ltd., 25 Mts., Rs. 3,94,627; Sri Gopalakrishna Poly Inds., 16 Mts., Rs. 2,59,491; Sun Polypacks P. Ltd., 15 Mts., Rs. 2,23,294; From Singapore: Asian Bags P. Ltd., 116.375 Mts., Rs. 10,18,701; Jampex Trdg. P. Ltd., 15.4 Mts., Rs. 2,23,064; Prestige Polycontainers Ltd., 204 Mts., Rs. 33,48,128; From UAE: Premier Syn. India Ltd., 17,150 Kgs., Rs. 2,60,304; Sunshine Plastic Inds., 17.15 Mts., Rs. 2,60,384; Sunshine Products, 34.3 Mts., Rs. 5,20,608.

POLYETHYLENE: From Korea: Kandine Poly Bags P. Ltd., 16 Mts., Rs. 2,55,560.

POLYPROPYLENE: From USA: Cirfab Pvt. Ltd., 66 Mts., Rs. 9,65,168.

PVC RESIN: From Yugoslavia: UB Mec Batteries Ltd., 81,600 Kgs., Rs. 15,12,556.

DRUG MATERIALS IMPORTED MADRAS (From 16.6.90 to 30.6.90)

AMPICILLIN TRIHYDRATE BP 80: From FRG: Alfred Ders & CC India P. Ltd., 147 Kgs., Rs. 15,000.

CEFOTAXIN SODIUM STERILE: From Italy: TTK Pharma Ltd., 10 Kgs., Rs. 1,80,501; From Korea: Chemech Labs Ltd., 2 Kgs., Rs. 38,032.

DOPAMINE HCl USP: From FRG: Pharma Research & Analytical Co., 20 Kgs., Rs. 79,536.

3-FORMYL RIFAMPYCIN: From Switzerland: Curekraft Chemicals Industries Private Limited, 530 Kgs., Rs. 17,71,200.

GENTAMYCIN SULPHATE BP 80: From China: DWD Pharmaceuticals, 120 Kgs., Rs. 3,73,275.

GRISEOFULVIN BP/USP MICRO: From China: American Remedies P. Ltd., 260 Kgs., Rs. 1,94,199.

PENICILLIN G POTASSIUM: From Japan: TTK Pharma Ltd., 7,584 Kgs., Rs. 32,25,020.

PERCHLORPERAZINE MALEATE BP 88: From Italy: Medopharm, 20 Kgs., Rs. 54,373.

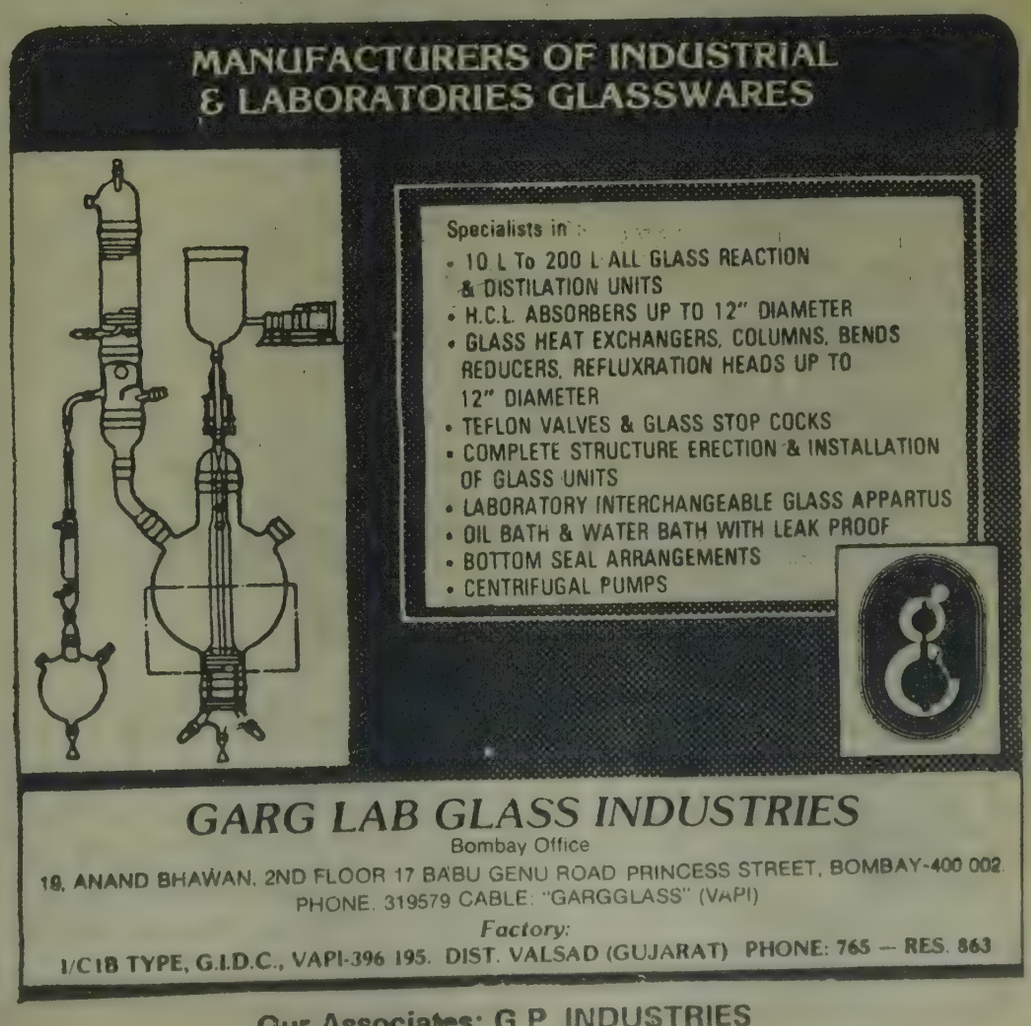
SULPHADOXINE BP 80: From Hong Kong: Bharat Lab Supplies, 400 Kgs., Rs. 2,76,592.

THYMOL BP/USP: From France: Chandra Industries, 2,000 Kgs., Rs. 1,81,800.

TRIFLUOPERAZINE BASE: From Hungary: Eskaylab Ltd., 1 Kg., Rs. 40.

MATERIALS EXPORTED BOMBAY (From 10.3.90 to 14.3.90) (Prices are f.o.b. values)

ACETIC ANHYDRIDE: To Mombasa: Sangula Enterprises, 490 Kgs., Rs. 10,213.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ALUMINIUM CHLORIDE: To Felixstowe: Aroni Chemicals, 19,800 Kgs., Rs. 2,77,917.

ALUMINIUM CHLORIDE ANHYDROUS: To Felixstowe: Mangalam Inorganic Ltd., 1,352 Kgs., Rs. 7,59,010.

AMINO G ACID: To New York: Nitro Chem Indl. Corpn., 2,500 Kgs., Rs. 2,06,000.

ANTHRAQUINONE: To Hamburg: IDI Ltd., 14,400 kgs., Rs. 9,86,000; To Norfolk: IDI Ltd., 15 Mts., Rs. 1,10,100; Mangalya Trading & Invest., 15 Kgs., Rs. 10,88,250.

AROMATIC CHEMICALS: To Osaka: Indl. Perfumes Ltd., 2,035 Kgs., Rs. 3,55,700; To Penang: S.H. Kelkar & Co. Ltd., 200 Kgs., Rs. 10,500.

CETYL ALCOHOL: To Hamburg: Aegis Chem Inds. Ltd., 2 Mts., Rs. 52,460.

4,4-DIAMINO DIPHENYL AMINO 2 SULPHONIC ACID: To Genoa: Ajay Chemical, 1,100 Kgs., Rs. 1,95,000.

4,4-DIAMINO STILBENE DISULPHONIC ACID: To Hong Kong: Vasant Chemicals P. Ltd., 1,053 Kgs., Rs. 1,20,194.

DIAMINO STILBENE DISULPHONIC ACID: To Piraeus: Monarch Dyestuff Inds., 1,150 Kgs., Rs. 1,16,596.

DIETHYL THIOPHOSPHORYL CHLORIDE: To New Orleans: Sandoz (I) Ltd., 61,749 Kgs., Rs. 15,68,786.

DIMETHYLAMINO ETHYL CHLORIDE HCl: To Hamburg: Mentor Chemicals & Pharmls., 3,500 Kgs., Rs. 4,40,681.

2,6-DINITRO-4-NITRO ANILINE: To Belfast: Nanavati & Co. P. Ltd., 6,096 Kgs., Rs. 7,70,000.

GAMMA ACID: To Keelung: Vivid Exports, 2,214 Kgs., Rs. 2,80,459.

H-ACID: To Keelung: Vivid Exports, 7,755 Kgs., Rs. 5,29,413; To New York: Atul Products Ltd., 15,600 Kgs., Rs. 9,72,851; Rang Udyog, 12,800 Kgs., Rs. 8,88,979.

IRON OXIDE RED: To Bangkok: Selective Minchem & Colour Inds., 72,000 Kgs., Rs. 1,05,309.

ISOPROTURON TECH 95%: To Le Havre: Montari Inds. Ltd., 7,500 Kgs., Rs. 13,76,302.

J-ACID: To Keelung: Vivid Exports, 1,000 Kgs., Rs. 1,95,064.

K-ACID: To Keelung: Vivid Exports, 7,000 Kgs., Rs. 4,99,389.

MENTHOL CRYSTALS BP/USP: To Hamburg: Bhagat Fine Chem, 2,000 Kgs., Rs. 6,30,000.

META AMINO PHENOL: To Hamburg: HOC Ltd., 16,000 Kgs., Rs. 31,00,446; To Osaka: HOC Ltd., 16,300 Kgs., Rs. 28,90,258.

META CHLORO ANILINE: To Kobe: Hiremath Chemicals Ltd., 5,250 Kgs., Rs. 4,85,426; To Rotterdam: Valiant Chemical Corporation, 1,000 Kgs., Rs. 99,000.

META PHENYLENE DIAMINE 4 SULPHONIC ACID SODIUM SALT: To New York: Coaltar Chemicals Mfg. Co., 6,666 Kgs., Rs. 6,25,000.

META PHENYLENE DIAMINE 4 SULPHONIC ACID: To New York: Vivid Exports, 2,577 Kgs., Rs. 2,57,123.

METANILIC ACID: To Rotterdam: Sadhana Nitro Chem Ltd., 28 Mts., Rs. 13,15,233.

METRONIDAZOLE BENZOATE: To Hamburg: Manjarati Chem., 2,000 Kgs., Rs. 4,40,000.

N.W. ACID: To Osaka: Sunbeam Monochem Pvt. Ltd., 402 Kgs., Rs. 47,915.

ORTHO TOLUIDINE BASE: To Le Havre: Sandoz India Ltd., 2,564 Kgs., Rs. 2,08,340.

PENTAERYTHRITOL (TECH): To Mombasa: United Breweries Intl., 16 Mts., Rs. 2,90,031.

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POTASSIUM IODIDE BP: To Hong Kong: Euresian, 1,000 Kgs., Rs. 2,60,426.

RED OXIDE: To Manila: Bharat Pulverising Mills Ltd., 62,350 Kgs., Rs. 1,13,206; 20 Microns P. Ltd., 5,000 Kgs., Rs. 10,000.

RESIST SALT 96%: To Rotterdam: Monarch Dyestuff Inds., 5,000 Kgs., Rs. 1,19,149.

SODIUM IODIDE BP: To Hamburg: Kirti Chemicals, 2,000 Kgs., Rs. 5,40,000.

SULPHO ANTHRANILIC ACID: To Bangkok: Vivid Exports, 1,863 Kgs., Rs. 1,12,341.

SULPHO TOBIAS ACID: To Jakarta: Espee Chemicals, 5,009 Kgs., Rs. 3,25,702; To New York: Vivid Exports, 4,480 Kgs., Rs. 2,76,299.

META UREIDO ANILINE HCl: To Jakarta: Espee Chemicals, 1,559 Kgs., Rs. 1,25,719.

VANADIUM PENTOXIDE TECH.: To Dubai: Catalyst India P. Ltd., 14,000 Kgs., Rs. 5,42,000.

VINYL SULPHONE ACETANILIDE: To New York: Vivid Exports, 5,350 Kgs., Rs. 4,25,197.

DRUG MATERIALS EXPORTED BOMBAY
(From 10.3.90 to 14.3.90)

AMOXYCILLIN TRIHYDRATE: To Copenhagen: Gujarat Lyka Organics Ltd., 600 Kgs., Rs. 6,37,466; To Hamburg: Kopran Chemicals Co. Ltd., 2,000 Kgs., Rs. 34,22,250.

BULK DRUGS: To Busan: Akai Impex Ltd., 1,500 Kgs., Rs. 3,47,447; To Rotterdam: Associated Chemopharm P. Ltd., 3,000 Kgs., Rs. 82,723.

CHLORAMPHENICOL PALMITATE: To Hamburg: Themis Agencies, 1,000 Kgs., Rs. 6,07,830.

CHLORPHENIRAMINE MALEATE BP 80: To Bangkok: Mehta Pharmaceutical Industries, 700 Kgs., Rs. 4,70,000.

DILOXANIDE FUROATE BP 80: To Singapore: Ipca Labs Ltd., 300 Kgs., Rs. 93,370.

ERYTHROMYCIN ESTOLATE BP 80: To Hamburg: Mehta Pharml. Inds., 2,000 Kgs., Rs. 19,66,000.

ERYTHROMYCIN STEARATE BP 80: To Hamburg: Haresh Tradelink, 1,000 Kgs., Rs. 11,12,935.

IBUPROFEN BP: To Copenhagen: M.J. Exports Ltd., 3,000 Kgs., Rs. 7,36,170; To Hamburg: Siris Ltd., 4,000 Kgs., Rs. 8,67,600.

PARACETAMOL BP/USP: To Mina Qaboos: FDC Ltd., 615 Kgs., Rs. 53,000.

PHENYL BUTAZONE USP: To Hamburg: Nukem Chemical Inds. Ltd., 5 Mts., Rs. 14,74,894.

SULPHAMETHOXAZOLE BP 80: To Hamburg: Chemox Marketing Associates, 17,000 Kgs., Rs. 33,98,298.

THIACETAZOLE BPC: To Mombasa: Unichem Labs Ltd., 400 Kgs., Rs. 8,70,000.

TINIDAZOLE: To Bangkok: Jal Ltd., 300 Kgs., Rs. 77,000; To Hong Kong: Euresian, 500 Kgs., Rs. 1,08,085.

TRIMETHOPRIM BP: To Bangkok: Bombay Drugs & Pharma P. Ltd., 400 Kgs., Rs. 2,14,452; To Penang: Orex Pharma P. Ltd., 500 Kgs., Rs. 2,69,787.

TRIMETHOPRIM BP 80: To Hamburg: Bombay Drugs & Pharma P. Ltd., 1,000 Kgs., Rs. 5,18,780; Chemox Marketing Associates, 2,000 Kgs., Rs. 10,79,149.

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ACID BLACK 52: To Charleston: Colour Synth Inds. P. Ltd., 2,000 Kgs., Rs. 2,57,983.

ACID BLUE 93: To Mombasa: Univ. Impex India, 500 Kgs., Rs. 1,28,915.

ACID GREEN 16: To Keelung: Liberty Exports Ltd., 300 Kgs., Rs. 97,872.

ACID RED 52: To Barcelona: Mangalya Trading & Invest., Ltd., 300 Kgs., Rs. 1,20,000.

ACID RHODAMINE: To Busan: Indokem Ltd., 400 Kgs., Rs. 1,87,830.

AURAMINE O CONC.: To Hong Kong: K. Patel Chemopharma P. Ltd., 3,000 Kgs., Rs. 1,76,000; To Mombasa: K. Patel Chemopharma P. Ltd., 800 Kgs., Rs. 55,000.

BENZASOL ORANGE 3R: To Mersin: Chemiequip Ltd., 2,000 Kgs., Rs. 2,86,332.

DIRECT BLACK G: To Rotterdam: Monarch Dyestuff Inds., 2,500 Kgs., Rs. 1,86,373.

DIRECT BLACK 38: To Genoa: Chemco Intl., 2,000 Kgs., Rs. 1,79,000; To Keelung: Chitra Dyestuff Inds., 1,000 Kgs., Rs. 77,000.

DYE INTERMEDIATES: To Antwerp: Arti Organics P. Ltd., 3,898 Kgs., Rs. 4,53,000; Metro Chem Inds., 16,016 Kgs., Rs. 13,51,489; To Baltimore: Atul Products Ltd., 4,600 Kgs., Rs. 9,23,800; To Bangkok: IDI Ltd., 4 Mts., Rs. 15,26,000; Vison Intermediates P. Ltd., 12,659 Kgs., Rs. 10,57,463; Vivid Exports, 35,882 Kgs., Rs. 36,04,518; To Busan: Zenith Ltd., 2,665 Kgs., Rs. 1,75,565; To Charleston: Anar Chemical Inds., 7,000 Kgs., Rs. 4,65,000; To Gdansk: Amritlal Chemaux Ltd., 2,700 Kgs., Rs. 3,41,361; To Genoa: Chemo Intl., 5,919 Kgs., Rs. 4,53,000; To Hamburg: Liberty Exports Ltd., 7,000 Kgs., Rs. 4,25,532; To Jakarta: Espee Chemicals, 6,213 Kgs., Rs. 7,21,107; Liberty Exports Ltd., 21,388 Kgs., Rs. 21,05,532; Metro Chem Inds., 1,550 Kgs., Rs. 5,58,277; To Kobe: Jay Chemical Inds., 18,300 Kgs., Rs. 23,00,000.

DIRECT BLUE 86%: To Kobe: Liberty Exports Ltd., 300 Kgs., Rs. 19,019.

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